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THE UNIVERSITY OF ALBERTA

THE DEVELOPMENT, IMPLEMENTATION, AND EVALUATION OF A PROGRAM DESIGNED TO PROMOTE COMPETENCY IN SKILL ANALYSIS

by

© MOIRA NICHOLL MCPHERSON

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
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OF DOCTOR OF PHILOSOPHY

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THE UNIVERSITY OF ALBERTA

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE DEVELOPMENT, IMPLEMENTATION, AND EVALUATION OF A PROGRAM DESIGNED TO PROMOTE COMPETENCY IN SKILL ANALYSIS submitted by MOIRA NICHOLL MCPHERSON in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY.

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Date June 29, 1987

Dedication

To Connie and Wendy,

For Their Confidence In My Ability To Succeed

Abstract

Advanced technology has enabled biomechanists to gather accurate quantitative measurements on many parameters related to human movement. However, the analytical tasks required of the teacher and coach are qualitative in nature. Kinesiologists and biomechanists have presumably believed that undergraduate courses in kinesiology and biomechanics develop a generic ability with which teachers and coaches analyze movement. While these courses may provide the student with an understanding of fundamental mechanical concepts, there is no data to suggest that they have had an influence on analytic ability (Armstrong, 1977; Hoffman, 1977; Huestler, 1939; Lewis, 1980; Locke, 1972; Ulrich, 1977). What is lacking in the traditional syllabus is a common thread which ties together all the important components of skill analysis.

There has been very little research devoted to either the determination or development of experience necessary for enhancing competence in gross motor skill analysis (Craft, 1977). This is true not only for preservice and inservice teacher/coach training programs but also for the community coach with no formal physical education training. The purpose of this study was to undertake the development, implementation, and evaluation of a program designed to promote skill analysis competency.

The training program was based on a holistic skill analysis paradigm which focused on performance technique. Skill analysis viewed as a totality was determined to consist of four major phases: (a) pre-observation, (b) observation, (c) diagnosis, and (d) remediation.

Associated with each of the phases in the developed training program was an instructional unit consisting of target goals, instructions, learning and practice activities, feedback, resources, visual materials, and assessment. The training program intervention was implemented as a course entitled *Strategies for the Observation and Analysis of Motor Skills*. The 40 hour course was offered as a seminar for Physical Education and Education undergraduate students, graduate students, and teachers. The course participants were introduced to the paradigm for skill analysis and then led in succession through each of the skill analysis components. The effectiveness of both the instructional strategies and the entire program was assessed using a series of qualitative and quantitative evaluations.

The qualitative information obtained from the 15 subjects emphasized an appreciation for the importance of a systematic approach to the skill analysis process. Participants felt that the skill analysis approach had provided them with an alternative to the identification of errors by trial and error. Both the content and the synthesis of the instructional strategies and units were reported as effective.

A single subject multiple baseline research design with probes was used to examine the efficacy of the intervention on a measure of skill analysis competency. The baseline phase of the study measured the subjects' ability to identify errors and determine primary errors from the video-taped performances of three skills. The postintervention phase measured the subjects' performance on the dependent variable following the sequential application of the skill analysis paradigm to two of the skills. The data were displayed over the course of the baseline and intervention conditions. Differences between the phases were visually inspected for observable changes in mean, level, variability, and trend. The results were: (1) the ability to identify errors and determine primary errors for the sport skills under baseline conditions was very poor, (2) the subjects significantly improved their ability both to identify errors and to determine primary errors following the application of the skill analysis paradigm to each skill, and (3) the subjects' ability to identify errors improved more than did their ability to determine the primary errors.

The skill analysis training program was concluded to have provided an effective means of changing skill analysis competency. Integration of the skill analysis program into future teacher and coach preparation programs is highly recommended.

Acknowledgements

> *Achieving...it can mean the sum total of your goals, aspirations and tommorrows. It can demand every ounce of drive and ingenuity you have. And, without a team committed to making it happen, it may not happen.*

I would like to thank my committee members for their interest and support throughout the course of this research project. Sincere appreciation is extended to Dr. Andrea Borys for her valuable suggestions regarding the implementation of the training program. Dr. Borys's enthusiasm and interest in the area of intervention and skill analysis were prime motivating forces throughout the study. Dr. Murray Smith's thoughts concerning the need for an applied emphasis on sport science research were indeed shared. Dr. Gervais's suggestions were always timely and thought provoking and my stay in this department was greatly enhanced by his friendship. I have been extremely fortunate to have had Dr. Jane Watkinson serve as my acting advisor. Dr. Watkinson's ability to excel in her many roles was incredible. Her interest in my progress never waived and her expertise was much appreciated.

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I would like to extend a special thanks to my external examiner, Dr. Shirl Hoffman. My philosophy and research in the area of skill analysis has been greatly influenced by his work. Dr. Hoffman contributed to an extremely enjoyable final examination and his suggestions and advice were greatly appreciated.

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Chapter I

INTRODUCTION

Feedback has been defined as a teaching behavior dependent upon the motor response of one or more students and one which is intended to provide information relevant to the acquisition or performance of a motor skill (Fishman & Anderson, 1971). More recently, Siedentop (1983) stated that feedback is information generated about a response that is used to modify the next response. The existence of a functional link between teacher or coach generated feedback and skill learning has been clearly established (Robb, 1972). Not nearly as well established is the process from which the feedback is derived.

Advanced technology has enabled biomechanists to gather accurate quantitative measurements on many parameters related to human movement. However, the analytic tasks required of the teacher and coach are qualitative in nature.

> Does the scientific equipment required by this specialized field preclude the measurement of properties of human movement by the practitioner? (Hensley, 1983, p.21)

The ability to form accurate feedback based on qualitative analyses implies the systematic and critical observation of motor skill performances and the subsequent identification of flaws. It is an ability which requires both the abstract analysis of a task as well as a visual dissection of the observed performance (Locke, 1972, p.381). If the structure of the traditional undergraduate physical education curriculum is any indication, the ability to analyze skills qualitatively is one which has been assumed, or perhaps hoped to be automatic. With the exception of a small but dedicated group of researchers, information regarding the development of analytic proficiency or indeed the analytic process has been less then impresssive.

Based on the literature it is conceivable that part of the problem stems from inconsistencies regarding the components of the analytic process and the terminology used. The terms *skill analysis, movement analysis,* and *observation* have frequently been treated as being synonomous. Discussions on the observation process in particular have been fraught with inconsistencies. Consider, for example, the following statements concerning observation in the teaching context.

> Observation as a teaching skill is what occurs before teachers make decisions. (Barrett, 1983, p.22)

> The other most emphasized area of observation is of an organizational nature, namely: uniforms, room or playing field environment, and formation. (Craft, 1977, p.44)

> Observation is concerned with sensation, perception, and attention... (Lewis, 1980, p.44)

Clearly, each of these statements describes slightly different areas. By treating observation as a teaching skill which includes everything prior to the decision making process, the importance of an initial conceptual movement analysis is undermined. Similarly, using the term *movement analysis* as an all encompassing term neglects the role which observation plays in the analysis scheme. Skill analysis is a complex process made up of a number of equally important components, however it is the synthesis of these components that results in analytic competency. In many instances theorists have focused on isolated components of the skill analysis process. Although this approach has resulted in a much greater appreciation of the nature and extent of the analysis process, it has to some degree overshadowed the importance of approaching the skill analysis process as a totality.

Several prominent researchers in the field recently have advocated a greater emphasis on the analysis process as a pedagogical skill which demands careful nurturing. Without question improvements in the quality of teacher and coach feedback rests on the development of this skill.

> Until a teacher has the ability to carefully observe and identify the movements involved in the execution of motor skills and has acquired a facility for communicating his observations to students, he is a teacher only in the figurative sense. (Hoffman, 1977, p.53)

The need to develop a holistic approach to the process of skill analysis was clearly indicated in the literature and is a focus of this study. Equally evident was the need to develop a training procedure to promote competency in this approach.

PURPOSE OF THE STUDY

The purpose of the study was to develop, implement, and evaluate a training program designed to promote competency in skill analysis.

RESEARCH QUESTIONS

In addition to addressing the main research objective outlined above, the project also aimed to address the following questions.

1. Did the application of the skill analysis paradigm evoke a positive change in skill analysis competency?
2. Was packaged intervention successful in changing teacher/coach analysis skills?
3. Was the training program a functional means of building analysis skills?
4. What variables impacted on the intervention procedures?
5. What are the difficulties, constraints etc... involved in teaching Physical Education students, coaches, and teachers to analyze the performances of gross motor skills?

DELIMITATIONS

The scope of the analyses was delimited to:

1. Physical education graduate and undergraduate students at the University of Alberta, and Physical Education teachers in the Edmonton area who agreed to participate in the study.
2. A specific number of closed skills.
3. A focus on skill technique.

DEFINITION OF TERMS

The following definitions will be adopted throughout the study:

Observation. In accordance with the definition supplied by Lewis (1980), observation is concerned with sensation, perception, and attention to a visual stimulus.

Movement Analysis. Movement analysis refers to conceptualizing and identifying the demands of the skill or movement. The main characteristics of this process are: definition of the purpose or goal, a movement simplification, identification of mechanical determinants, and the identification of critical features.

Primary & Secondary Errors. Errors may be primary or secondary. A primary error is an error which is the main problem and should be the focus of remediation. Secondary errors are problems or errors which are symptoms of larger errors i.e.: the primary errors. Secondary errors are important as they may furnish information concerning the primary errors, however efforts to correct the secondary error will not correct the real problem.

Skill Analysis. The term skill analysis refers to a process which includes; conceptually analyzing a movement, observing the performance of a movement, diagnosing discrepencies between the desired response and the observed response, and forming and providing remediation. Skill analysis is a precursor to the provision of feedback.

Technique. Technique is respected when different motor components combine in a logical sequence, when there is a summation of forces with these forces being directed in the direction of the movement (Salmella, 1976, p.102). *Optimal technique* refers to the most mechanically efficient performance of a movement pattern within the constraints and requirements of the skill or activity.

ORGANIZATION OF THE DISSERTATION

There are a number of ways in which this dissertation could have been presented. The style ultimately chosen was considered to be the best way in which the development, implementation, and evaluation of the skill analysis training program could be described and discussed. A reliance on qualitative material in this study has resulted in the inclusion of many quotes taken from the journals of the participants. These quotes are clearly evident in the text and are referenced only to the specific subject number.

Chapter II provides a review of the research considered central to the study. Approaches to the process of skill analysis, factors which are believed to influence analytic ability, and attempts to train competency in movement analysis are considered in detail. Following a summary of the foregoing, research dealing with the design and evaluation of intervention techniques is presented and discussed.

The primary focus of Chapter III is the development of the skill analysis paradigm. Each of the phases included in the holistic approach is defined and justified, and the paradigm which ensued from the review of the relevant research is presented.

Chapter IV provides a description of the development of the Preliminary Field Test(PFT). The content and structure of the training program is first considered followed by the determination of the PFT format.

In Chapter V, the methods which were used to implement and analyze the Preliminary Field Test are described.

The analysis and discussion of the PFT results is the focus of Chapter VI. The results are presented and discussed under the following headings; components of the instructional units, feasibility of the format and imposed time constraints, impact of the training program, impact of the skill analysis paradigm, examination of the suitability of the changing criterion design, and supplemental information. The chapter is concluded with a summary of the actions taken as result of the Preliminary Field Test.

The Final Field Test(FFT) of the skill analysis training program is the focus of Chapter VII. The development, implementation, and analysis techniques are all detailed.

Chapter VIII is directed towards the discussion and analysis of the results from the Final Field Test. The results are presented and discussed under the following headings; initial status of the learner, learner performance following a period of instruction, execution of the treatment, cost, and supplemental information. In the final section of this chapter the results are synthesised and the main research questions addressed.

Finally, Chapter IX provides a summary of the results and conclusions of the investigation. In addition, the implications of the study and a number of recommendations for future investigations are presented.

Chapter II

REVIEW OF THE LITERATURE

APPROACHES TO THE PROCESS OF SKILL ANALYSIS

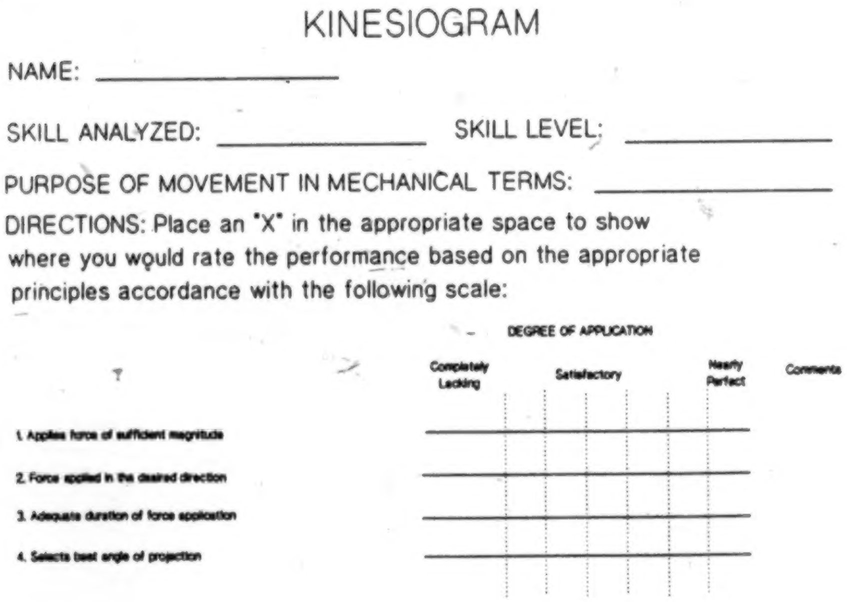
Based on the review of the literature dealing with the process of skill analysis as a prerequisite for augmented feedback, four distinct components have been identified; pre-observation, observation, diagnosis, and prescription. The quality of each component rests entirely on the quality of the previous component. Typically, those investigators who have advocated various approaches to skill analysis, have dealt only with isolated components of the process. This is not to state that implicit in the research has not been a recognition of the importance of each of the components, but rather to suggest that for each of the investigators only one or two of the components have served as the framework or base from which their work has stemmed. The purpose of this section is to present and discuss the various approaches that have been proposed for the process of skill analysis with reference to the components which have served as their base.

PRE-OBSERVATION

There has been an increased awareness of the importance of the pre-observation component in the process of skill analysis (Arend & Higgins, 1976; Barrett, 1977; Hay & Reid, 1982; Lewis, 1980; Robb, 1972). A variety of phrases have been used to describe the objectives of this component, such as the establishment of a knowledge base, classification and analysis of the movement, and decisions on what to observe. However, common to all discussions has been the concern for conceptually organizing movement in an attempt to structure the analysis process.

To facilitate the qualitative analysis of human movement, Hensley (1983) advocated a pre-observation component based on the identification of the mechanical principles applicable to the task at hand. "In accordance with basic measurement theory, the first step must be to identify the characteristics or qualities to be measured" (Hensley, 1983, p. 21).

According to Hensley, the next step in the analysis procedure is the development of a measurement instrument which serves to guide the observation stage. The Kinesiogram, a scoring system which allows for discrimination of the performer's ability to adhere to mechanical principles, was proposed as a viable measurement instrument (refer to Figure 1.). Clearly the effectiveness of analyses using the Kinesiogram is dependent to a large extent on the quality of the pre-observational preparation as well as on the amount of practice observing and recording with the instrument. Hensley's approach is useful not only for the emphasis on the pre-observation component of analysis but also for the concern with the process of recording observations. The approach, however, does not provide the practitioner with a method of determining the degree of adherence to the mechanical principles and this is a weakness of the recording instrument. For example, how does one determine if the appropriate amount of force was applied, or if the transfer of momentum was maximized? The prior identification of critical features would do much to alleviate this difficulty.



KINESIOGRAM

NAME: ____________________

SKILL ANALYZED: ________________ SKILL LEVEL: ________________

PURPOSE OF MOVEMENT IN MECHANICAL TERMS: ____________________

DIRECTIONS: Place an "X" in the appropriate space to show where you would rate the performance based on the appropriate principles accordance with the following scale:

DEGREE OF APPLICATION

	Completely Lacking	Satisfactory	Nearly Perfect	Comments
1. Applies force of sufficient magnitude				
2. Force applied in the desired direction				
3. Adequate duration of force application				
4. Selects best angle of projection				

Figure 1. Kinesiogram (Adapted From Hensley, 1983, p. 22).

The identification of critical features is a concept which has frequently surfaced as a focus of the pre-observation phase (Arend & Higgins, 1976; Barrett, 1979; Brown, 1982 ; Hoffman, 1977; Kreighbaum & Barthels, 1981; Newston, 1976; Robb, 1972). Critical features are those aspects of movement which are the major determinants of the outcome of the performance. "It can not be said, unequivocally, what should be the focus of our attention in all movement situations, but it is obvious that whatever we decide to look for it must be critical to the movement being performed" (Barrett, 1979, p. 23). The process of identifying critical features is far from a simple task and may imply a broad knowledge of anatomy, physiology, motor learning and biomechanics. Newston (1976) suggested that skillful observers use critical features as a means of perceptual organization. The observer's skill in feature selection not only focuses the observation process but also controls the amount of information which needs to be stored in short term memory.

> Given the limited capacity of short term memory a critical part of observer skill may be that of feature selection....A skilled observer may thus be the one who selects the least redundant set of critical features for the perceptual organization of the event, thus insuring maximal information gain from a given episode.
> (Newston, 1976, p. 120)

A number of investigators have approached the process of skill analysis with an emphasis on the identification of critical features based on the goal of the skill and the mechanical factors which are essential for attainment of that goal. Hay & Reid (1982) proposed a system whereby theoretical models are used as the basis for the identification of faults and judging of their relative importance. Like Hensley (1983), Hay & Reid support an approach that is based on the knowledge of fundamental biomechanical principles.

> This model serves to supplement whatever expertise the teacher or coach may have and to channel or direct the analysis in a logical or systematic fashion.
> (Hay & Reid, 1982, p. 266)

A qualitative model, also referred to as a block diagram shows the relationship between the result and the factors that produce the result. The procedure for developing a theoretical model for a specific skill is initiated by the identification of the performance criterion. The purpose of skills which are judged objectively is easily ascertained. Clearly, the desired outcome in the performance of the high jump is maximum height. In the analysis of skills which are judged subjectively, the purpose may be more difficult to define. Often such skills are evaluated in terms of the contribution they make to the aesthetics of the total performance.

The second step in the process is to determine whether the result may be broken into a series of distinct consecutive parts. For instance, in the case of long jumping the horizontal distance that the athlete's centre of mass travels is the sum of the distance travelled during the take-off, flight, and landing. The model is thus greatly simplified by separating the actions occurring on the ground from those occurring in the air.

Identifying those variables and critical features which influence the result are the final steps in the development of a theoretical model. Each of the variables or factors included in the model must be completely determined by the factors connected to them from the lower levels and should be mechanical quantities whenever possible. Kreighbaum & Barthels (1981), in their discussion on the process of qualitative analysis, stressed the importance of thoroughly examining the skill so that only the major mechanical principles which govern the effectiveness or ineffectiveness of a skill are first identified.

> Within each mechanical principle there are numerous variables that influence the quality of the performance and determine how well the performer adhered to the mechanical principle. (Kreighbaum & Barthels, 1981, p. 454)

In theory, the model is designed to allow the practitioner to view a performance using critical features as comparators for pinpointing the sources of error. At the lowest level of the model are the critical features. A good theoretical model should serve to focus attention on the features most likely to limit the attainment of the performance criterion. Figure 2. is an example of a theoretical model of the waltz jump, a fundamental jump in figure skating.

PRE-OBSERVATION & OBSERVATION

As has been previously discussed, the literature is fraught with inconsistencies concerning the definition of observation and its relation to skill analysis.

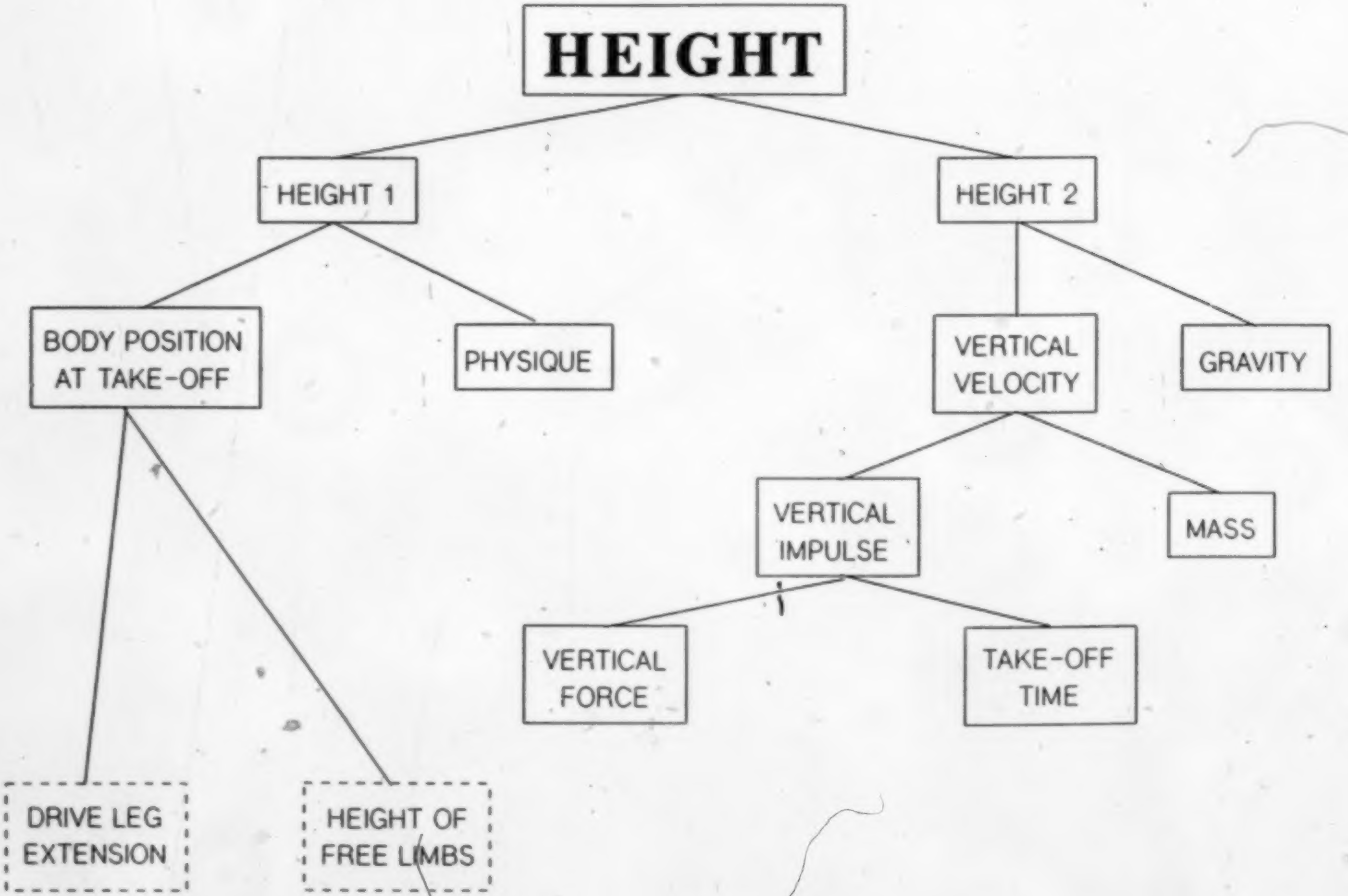


Figure 2. A Theoretical Model for the Waltz Jump

Much of the published research has treated the two terms as being synonymous (Arend & Higgins, 1976; Godwin, 1975; Hoffman, 1977: Imwold & Hoffman, 1983). Godwin (1975), for example, described the observation process to be a complex pattern of interelated activities including; (a) the selection of what is to be observed, (b) selection of appropriate methods of looking and, (c) categorization , assessment, and evaluation of information (p. 73). In the subsequent discussion on training observers, the importance of personal experience and a knowledge base was stressed. "We can only select from what we know, the wider and deeper our knowledge base the more choice we have" (Godwin, 1975, p. 74). Clearly, Godwin's approach encompasses far more than just sensation, perception and attention.

By far the individual most concerned with the conceptualization of observation has been Kate Barrett. Barrett's (1977) research has stemmed from the contention that observation is the key component in a cyclical teaching-learning process.

> While there is basically nothing new in the cyclical model of observation, interpretation and intervention, as a profession we have not carefully studied it either in this specific relationship or within the boundaries of the ongoing teaching learning process. When viewed in this particular pattern, what becomes crystallized is the key role that observation plays in the teaching learning process. (Barrett, 1979, p. 181.)

In 1979, Barrett examined the responses of 30 junior physical education majors involved in a course designed to improve their ability to observe in teaching and coaching environments. After a subjective analysis of the students' journals three principles of observation emerged.

1. _The Principle of Analysis_

   The need to analyze the movement prior to attempting to observe was deemed essential. Without the pre-observation work students were unable to identify what to look for. Corollary to the ability to analyze is the concept of critical features.

2. _The Principle of Planning_

   In general the students agreed that in order to glean the maximum amount of relevant information from an observational experience, an observational plan was required. Key considerations for the plan were organization and possible scanning strategies.

3. The Principle of Positioning

The importance of considering the effect of different positions on the subsequent observations came somewhat as a surprise to the students involved in the study. A conscious effort must be made to "be in the right place at the right time" (p. 25).

More recently, Barrett (1983) has conceptualized a model for observation as a teaching skill which has three components; (a) deciding what to observe, (b) planning how to observe, and (c) knowing what factors influence the ability to observe. For this model observation was defined as the ability to perceive accurately the responses of the learner and the environment. "Seeing what is there and not what is thought to be there" (p. 22). However, observing as a teaching skill was defined to include everything which occurred in the analysis process prior to diagnosis. As in Barrett's earlier discussions, the identification of critical features were considered central to the ability to observe. What is somewhat confusing about Barrett's discussions is that despite her contention that skill analysis is just a small part of the observation process she devotes a major portion of her models to the pre-observation or movement analysis component. Furthermore, while the factors which affect the observation process are considered, few strategies for observing and recording observations are actually provided.

OBSERVATION

"Beginning in the mid 1960's a number of schemes for analyzing and observing movement were developed based on the work of Rudolph Laban. Laban developed a system of observing human movement which remained constant regardless of the movement's purpose" (Craft, 1977, p. 53). The four major components which provide a framework which make up Laban's system are: body (what the body can do), space (where the body can move), effort (how the body can move), and relationships (with whom or what the body moves) (Craft, 1977, p. 53). While Laban's system has been widely applied it does not lend itself to a process of skill analysis which attempts to diagnose errors in performance and form remediation to improve technique as operationally defined for this study.

Several investigators have also approached the observation process from a biomechanical framework. Cooper (1972) suggested one approach to the analysis of an activity or sport which is based on an observational checklist . A summary of Cooper's checklist is provided below. The approach may be of value to the observer in the sense that it draws attention to a number of specific movement components which frequently demand consideration. The approach fails to consider the identification of criteria necessary for evaluating the responses to the analysis checklist.

1. Look at the "hub of the wheel" before the rim.
2. Observe the height of the centre of mass.
3. If hip movement is essential, observe the extent and direction of the motion.
4. Observe the body weight at the start and completion of the motion.
5. Observe the motion of the head.
6. Check the width of the base of support.
7. In what direction do the feet point initially and during motion?
8. How much sway, dip, and unusual twists of the body occur during the action?
9. What is the extent, direction, and pattern of the follow-through of the arms, hand, etc...?
10. What is the direction of the arm and leg motions?
11. What is the range of motion of the body segments?
12. Observe the position of the hand or any implements at the point of impact.
13. What is the action of the wrist, hand, and fingers at the point of contact or release of an object?
14. Observe the angle of release or take-off of an object or the body.
15. Where are the eyes of the performer focused?
16. What is the total visual perception of the performer as detected by the observer?
17. How effective is the total body movement?

A series of visual evaluation techniques were developed by the Youth Sports Institute of the State of Michigan to assist the volunteer coach with little or no background in kinesiology or biomechanics. The techniques are based on a process rather than a product paradigm. This is to suggest that it is the quality of a movement that is the focus of the analysis rather than the outcome (Brown, 1984). Visual techniques are grouped into the following five categories: (a) vantage point, (b) movement simplification, (c) balance and stability (d) movement relationships, and (e) range of movement. In each of the categories the rationale for the concept and a number of strategies are presented. Brown (1984) suggests that to be most effective the techniques should be applied in three stages. First, the best vantage points must be established prior to observation. During observation the coach should use the techniques discussed to collect information concerning the quality of the movement. Finally, the information is used to provide an evaluation of the movement.

Visual Evaluation Techniques is a flexible approach to skill analysis and offers some good suggestions. The structure of the approach lends itself both as a method of addressing and recording observations. Like other approaches previously discussed, Brown's approach is based on mechanical principles and the derivation of the critical features, however he attempts to present the material in a way which does not require the knowledge of these principles. As with Cooper's checklist the approach does not provide any insight on developing techniques for synthesizing the observations. Nor does it provide for the analysis of movements which may be idiosyncracies or for the identification of errors which may be symptoms of more important errors (secondary versus primary errors). The work of both Cooper (197?) and Brown (1984) should be applied only as a guide to the analysis process. It is doubtful that accurate and effective feedback concerning skill technique could be provided solely on the basis of these approaches.

Craft (1977) completed an inquiry into a model for training undergraduate physical education majors to observe movement. Like Barrett (1977), the driving force behind Craft's research was the strong contention that observation is a skill which demands attention in its own right.

> The need for physical education as one of the professional preparation programs for teachers to emphasize observation as a skill to be used during the teacher learning process is supported in the literature. The nature of physical education being one of action, movement, I wonder what the teacher who can not observe movement uses as

a basis for instruction. (Craft, 1977, p. 43)

The model was composed of three interrelated elements; the observer, the movement framework, and the environment. Elements in the model were structured to create a change in the observer's ablility to observe. The element of the model which focused on the observer included three concepts; developing awareness, ability to concentrate and to hold the focus, and recognition of personal biases. The second element of the model was adapted from Laban's work. The environment dealt with the types and structure of experiences used. A workshop comprised of ten sessions over a four week period was conducted to present the observation model and provide practice in applying the movement framework to observation. The components of the movement framework were gradually introduced through visual and movement experiences which attempted to increase the observer's awareness, decrease the effects of personal biases, and increase the observer's concentration. A discussion of the techniques and procedures used to evoke changes in the participants is provided later in this chapter. The model was found to be a functional means of building observation skills.

Craft's research is less interesting for the modest gains made by the participants than for the thought provoking discussion on observation and analysis. Craft first distinguishes between the focus of observation for managerial skills and the focus of observation for analysis. Both types of observations should demand an ability to accurately perceive movement and the environment, however observation for skill analysis has typically required a pre-determined standard of what the movement should look like and an implied focus on the observation and analysis of specific skills.

> In learning to analyze the emphasis is usually what the performer is not doing but should be doing in order to perform the skill correctly The analysis is made against some pre-determined standard of what the expert performer looks like.
> (Craft, 1977, p. 54)

Using the expert performance as a basis for analyzing an individual's skill has proved to be an ineffective approach. Each individual possesses a variety of abilities, past experiences, desires, capabilities, and limitations which all serve to alter the performance of gross motor skills. To judge a performance strictly on the basis of a pre-determined standard is to ignore the concept of individual differences. Craft attributes the ineffectiveness of this approach to a lack of concern for what is actually occurring. She continues her discussion by building a case for the teaching of observation as a totality.

> Since each of the skills is made up of various movements, it seems to me that teacher preparation programs could use time more wisely if they were to teach observation of movement as a totality. If prospective physical educators are taught to observe movement, they could learn to apply their observational abilities to any movement within any skill. (Craft, 1977, p. 51)

In effect, Craft is supporting the notion of teaching observation skills generically. The ability to accurately perceive the performer and the environment is a prerequisite for any type of analysis. Once generic observation skills have been acquired the teacher or coach can then draw on them for the analysis of any specific movement. However, the teacher or coach is still left with the task of learning an analysis procedure for each specific skill. If we accept that the ability to analyze movement is a trainable skill and is dependent on adopting a systematic approach, then does it not make even more sense to teach the entire analysis process as a totality?

DIAGNOSIS AND REMEDIATION

In contrast to the work completed by the majority of researchers interested in the process of skill analysis, Hoffman (1982) has provided both an innovative and valuable conceptualization of the post-observation phase. A Hypothetico-deductive model is posed as a diagnostic solving tool (refer to Figure 3.). The model is based on the assumption that discrepencies between the observed and desired response require specific prescriptions. Hoffman defines diagnosis as the recognition of the nature and extent of the discrepancy followed by the identification of the causes of the discrepancy. Prescription is viewed as the application of a remedy. Hoffman states that skill teachers are confronted with three major clinical-diagnostic decisions. A summary of these decisions follows.

1. Has the learner performed the skill correctly?
2. If the skill has not been performed correctly, what features of the performance are errors and which are a result of the primary errors?
3. What prescription will remediate the primary errors?

The model attributes the observed discrepancies to one of three general defects; critical ability, skill performance deficiency, or psycho-social problems. In this way the remedies for specific errors may be more easily deduced.

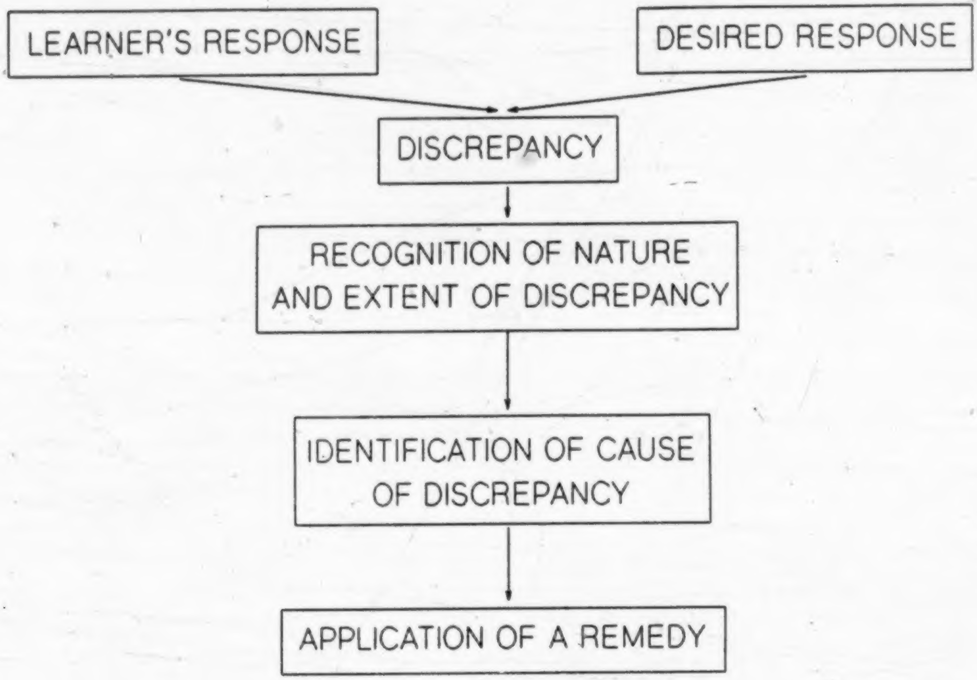

LEARNER'S RESPONSE
DESIRED RESPONSE
DISCREPANCY
RECOGNITION OF NATURE AND EXTENT OF DISCREPANCY
IDENTIFICATION OF CAUSE OF DISCREPANCY
APPLICATION OF A REMEDY

Figure 3. Diagnostic Prescriptive Model of Skills Teaching (Adapted From Hoffman, 1982, p. 37)

The hypothetico-deductive model is innovative in the sense that it approaches skill analysis in much the same way that a computer scientist approaches a program development. All input possibilities are accounted for by integrating a number of subroutines. Therefore, regardless of the nature of the discrepancy there is a route of deductive reasoning, a subroutine, for the analyst to follow. It is of interest to note that while Hoffman describes the model as a clinical inquiry which focuses on the search for primary errors he also points out the lack of a clearly established relationship between the determination of primary errors and a knowledge of biomechanical principles.

> Experienced clinicians teaching skills with which they are familiar may not resort to trouble shooting. Through repeated analysis of the skill, they have learned to focus directly on the source of difficulty. Some may not even appreciate or understand the mechanical laws that govern the relationship between secondary and primary errors. Granted this does not mean that a knowledge of mechanics would not improve their diagnostic capabilities, but that remains a question to be examined.
> (Hoffman, 1982, p. 4)

While there have been a number of attempts to discriminate between the novice and expert observer very little has been learned. It is the contention of the present author that experienced instructors gain analytic proficiency through vast analytic experience and despite their lack of an understanding of the fundamental mechanical laws. Regardless, the literature has suggested that those who may be considered as competent are a minority. The inexperienced observer is faced not only with the task of deducing the cause of a primary error but also with the difficult task of distinguishing between primary and secondary errors. One would expect that the understanding of fundamental mechanical laws would facilitate this process.

AN INTEGRATED APPROACH

Arend and Higgins (1976) presented, what is to date, the most comprehensive approach to the classification, analysis and observation of movement. The Arend & Higgins strategy is the only approach which attempts to unify, organize, and integrate the subject matter from a variety of disciplines in a generic approach. Additionally, the effectiveness of the strategy depends entirely on systematic progression through the entire analysis process. A variety of items, activities, questions and criteria are addressed in each of the three analysis stages: pre-observation, observation, and post-observation. The strategy is designed as a holistic approach to the subjective analysis of movement (refer to Figure 4). As with other investigators, Arend & Higgins stress that the pre-observation phase is paramount to the success of the strategy.

> Essentially this level of the descriptive analysis represents the synthesis of pre-requisite information to teaching itself along with serving the function of setting the stage for meaningful observation and evaluation.(Arend & Higgins, 1976, p. 3)

In the pre-observation phase a three dimensional breakdown of the skill is suggested. The phase is initiated by defining the purpose of the skill and is concluded by an examination of the biomechanical and other relevant correlates. In support of the previously reported approaches, a focus of this stage is the identification of critical features. Discussion on the observation phase centers around the need to systematically plan and record observations. The authors offer three approaches to the recording of observations: (a) critical features are identified for each phase of the movement then subsequently observed, (b) a series of questions are constructed based on a segmental analysis and are answered after each of a number of observations, and (c) the observer constructs his or her own set of questions with the goal of aquiring enough information to provide effective feedback (p. 46). The only area which is weak in the proposed stategy for movement analysis is the observation component. While the foci of observation are carefully derived and isolated, suggestions for specific observational strategies are non existent.

A unique feature of the work of Arend & Higgins is their consideration of the post-observation phase. With the exception of their work and the work of Hoffman (1982), discussions on the post-observation component have offered little insight into the processes involved. If we accept that the provision of feedback is the criteria by which we judge competence in movement analysis then an understanding of the post-observation phase is crucial. Arend & Higgins provide guidelines first for the evaluation of a performance on the basis of efficiency criteria, and secondly for the organization of feedback.

The strength of the strategy for the classification, analysis, and observation of movement, lies in its support of a holistic approach to the skill analysis process. Viewed in this context, the skill analysis process can be trained, assimilated, and adapted for the analyses of any skill or movement.

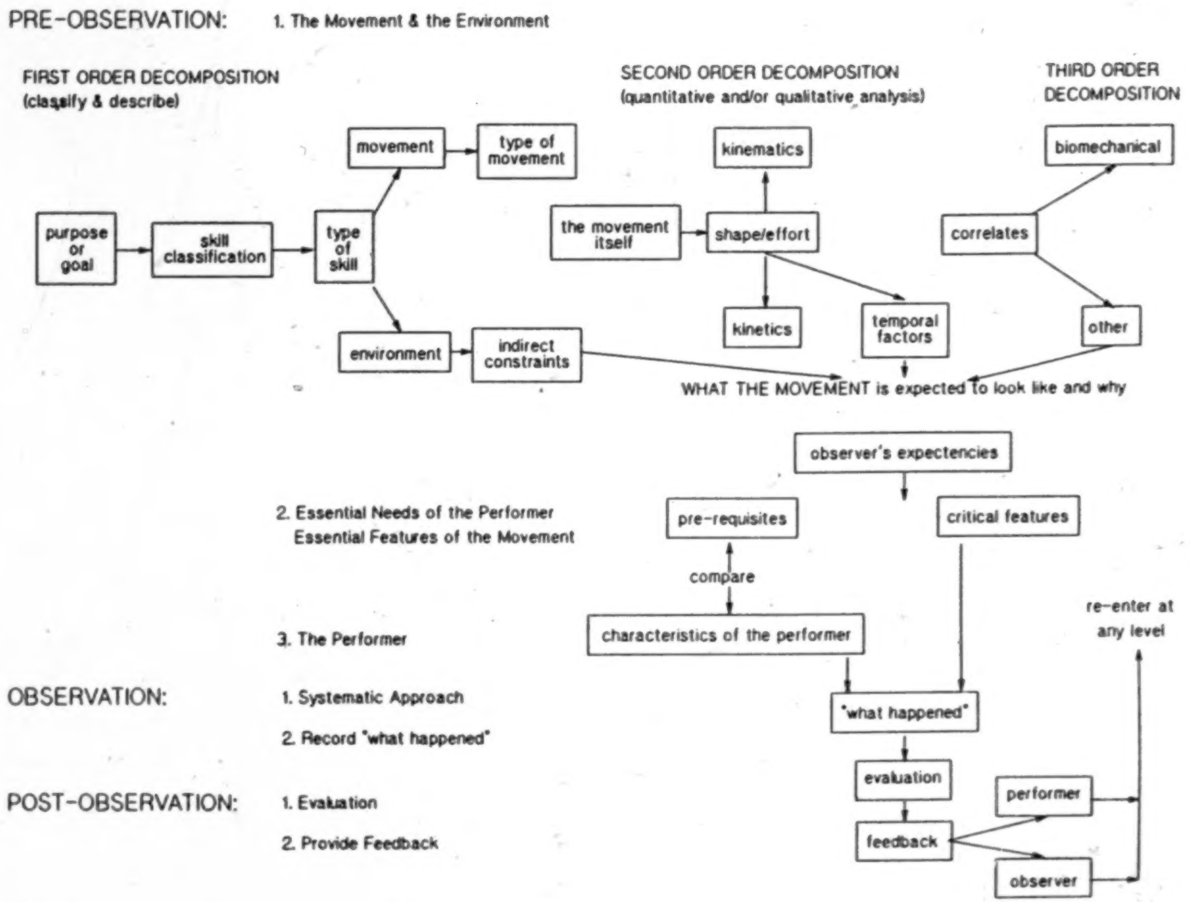


Figure 4. A Strategy for the Subjective Analysis of Human Movement (Adapted From Arend & Higgins, 1976, p. 38)

FACTORS WHICH INFLUENCE ANALYTIC ABILITY

The role of skill analysis as a precursor to the provision of effective feedback has been clearly established. Within the context of skill instruction, performances of gross motor skills must be conceptually analyzed, observed, errors diagnosed, and remediation formed. Unfortunately, research on how to prepare teachers and coaches for this critical task has captured little attention. Typically, writers who have advocated various approaches to the skill analysis process have provided brief accompanying discussions regarding the factors believed to influence the analytic process.

The factor which was most frequently identified is the need for a knowledge base (Arend & Higgins, 1976; Barrett, 1979; Hay & Reid, 1982; Hensley, 1983). The extent of this knowledge base has ranged from biomechanical principles, a broad view of anatomy, physiology and motor learning, to a knowledge of what consitutes good form and what performance levels can be expected at different maturational levels. Unfortunately, there have been no efforts to validate the effect that a knowledge base has on analytic competency.

Barrett (1979), in her study of undergraduate physical education majors, identified various factors which seemed to affect student success in observing pre-determined critical features. They were: concentration, the type of movement response anticipated, ability level of the performers, number of performers, and the speed and repetition of the movement. As a result of further investigations, Barrett (1983) later added fear, excitement, worry, complexity of the movement, size of the teaching area and the observer's personal ability to the list. Barrett's findings led her to the conclusion that teachers may be poor observers because their attention is constantly being diverted or challenged by distractions (Barrett, 1979,p. 29). Barrett continued by stressing the need for observers to shift their focus to the perceptual complexites of the teaching process.

Craft (1977) attempted to train observers to see movement as a totality. Craft focused on three factors which she believed influenced this ability; personal bias, observer awareness, and the ability to concentrate. Lewis (1980), in a discussion on structured observation, pointed out the effects of a number of variables on the observer's perceptual processing capacity.

> The experience of the performer will determine to a great extent whether they know the probabilities of either a stable or changing environment...(Lewis, 1980, p. 41)

> The expert is able to monitor certain movement patterns at a level that does not have to be under conscious control. Once something is learnt and automated it is removed to a lower level of operation and does not have to be consciously monitored all the time. (Lewis, 1980, p. 41)

> People in very high arousal situations often do not perceive what they would normally perceive. (Lewis, 1980, p. 41)

The development of visual strategies such as monitoring, scanning, and filtering as techniques for critically selecting relevant bits of information, have been highlighted by a number of investigators (Barrett, 1983; Godwin, 1975; Lewis, 1980; Newston, 1976; Robb, 1972; Spaeth, 1972; Whiting, 1972)

> Man is continuously sampling output. A form of monitoring occurs which allows him to evaluate the state of the system with respect to the objective. (Robb, 1972, p. 370)

> ...there is only limited time available for which to take in informatiom, he needs to be selective. (Whiting, 1972, p. 276)

The purpose of this particular section of the literature review is to discuss the factors which influence analytic proficiency and have been queried through empirical investigation.

EXPERIENCE IN PERFORMING A SKILL

It has been hypothesized that to effectively analyze motor skills physical activity instructors must themselves have had experience in the performance of those skills. A relationship between performance ability and analytic ability frequently is cited as a justification for this emphasis (Armstrong, 1983).

> Physical education trainees are required to spend countless hours in learning a vast array of sport skills. the emphasis seems to be on making sure that each student has experience in performing these skills that he, as a professional may be called upon to teach at a later date (Armstrong, 1976, p. 13).

In only one of the reviewed studies was there evidence to support this hypothesis. Girardin & Hanson (1967), filmed 32 male physical education students performing 11 tumbling skills. A panel of judges then rated the performances and a total score for each subject was calculated. Ablility to diagnose errors was determined by having each subject view a filmed tumbling performance and list all the errors. The subjects' score was derived from the number of errors which matched a list previously compiled by the judges. The investigators found that a significant relationship existed between the ability to diagnose performance errors in tumbling skills and the ability to perform the skills. However, methodological limitations of this study should be pointed out. First, there were no controls for the degree of prior tumbling experience. It is quite feasible that those individuals who scored highly on both the ability to perform and ability to diagnose, had several years of experience as a gymnast or coach. This would imply an extensive amount of exposure to visual, kinesthetic, and instructional feedback. Secondly, the validity of the diagnostic ability instrument is questionable. The detection of errors from filmed performances is dependent first on the individuals perceptual ability. As Imwold & Hoffman (1983) stated, error detection tests mask important subcomponents of the diagnostic process making it impossible to determine whether the observers problem is a result of an inability to perceive the response or an inability to classify it as correct or incorrect (Imwold & Hoffman, 1983, p. 150).

Osborn & Gordon (1972), examined the effect of skill in performing a tennis stroke on the accuracy of rating a tennis stroke. Ninety male undergraduates were divided into three groups on the basis of their tennis skill level. Each group viewed 16 different staged performances of a tennis stroke and rated the performances using a six point check list. Each item on the checklist was a statement concerning the movements of a body part. The rater's personal skill was found to have no relation to the overall accuracy of the ratings.

More recently, Armstrong (1976) investigated the relationship between skill analysis and kinesthetic experience. Subjects were divided into three experimental groups which differed only in the degree of physical training which they received on a novel movement pattern. Following the treatment, subjects were required to complete a test on their ability to recognize the the existence and location of movement variations in the model skill. The results of the data analysis failed to support the hypothesis that kinesthetic experience and analytic ability are related. Armstrong cautioned that the amount of experience given to the groups may have been insufficient to induce changes in analytic ability. Furthermore, the separation of kinesthetic experience from visual experience may represent an unrealistic situation. Of more relevance would be the determination of a relationship between the combination of visual, kinesthetic, and instructional feedback experiences derived from practical experience as a performer or instructor, with analytic ability.

> For any given skill the teacher with the analytic advantage is the one who has performed, practiced and studied specific components of that skill.
> (Locke, 1972, p. 382)

Despite the methodological limitations inherent in all these studies, there is no evidence to support the existence of a significant relationship between performer ability and analytic ability. On the basis of this conclusion, an examination of the current objectives (and the means of achieving these objectives) of physical education teacher preparation programs may prove to be necessary.

TEACHING EXPERIENCE

Experience with tasks involving skill analysis, such as skill teaching, rating or judging, has also been hypothesized to enhance analytic ability (Armstrong, 1983, p. 4). Data from a number of investigations support this hypothesis. Biscan & Hoffman (1976), for example made comparisons between physical education teachers, students, and classroom teachers on their ability to analyze both a cartwheel and a novel skill. The teachers and students who were familiar with the cartwheel performed significantly better on the analytic task than those who were not familliar with the cartwheel. Interestingly enough, there were no significant differences on the ability to analyze a novel task, suggesting that analytic proficiency is specific to one's experiences.

Similarily, Armstrong & Hoffman (1979), found a significant relationship between the amount of experience and the ability of tennis instructors to identify common performance errors. However, the results suggested that the differences exhibited by the experienced teachers were due to their increased ability to discriminate what they chose to identify as a performance error rather than increased sensitivity to error signals. They concluded that the significant differences between the tennis professional and the preservice physical education students were more the result of observational and analytical experience gained through teaching rather than through actual playing practice.

In a recent study by Imwold & Hoffman (1983), three groups with different levels of teaching experience (undergraduates, physical education teachers, and experienced coaches) were tested on their ability to recognize previously viewed gymnastic performances. All subjects viewed a film which was stopped at a number of selected frames. Following the film viewing they were presented with drawings traced from isolated frames of both the presentation film and a non-viewed film, and were required to recognize the previously selected frames. The results confirmed the findings of previous studies which have shown recognition to be a function of level of experience and familiarity with a skill. However, much to the surprise of the investigators was the finding that the physical education teachers performed no better than the undergraduate students. This would imply that the standard teaching experience effects no improvement in analytic expertise. Imwold & Hoffman attributed this result to the diversity of teaching instruction required of the physical education teacher.

> Given the diversity of their teaching responsibilities and the limited amount of time allotted to teaching any single skill in an instructional year, it may be unrealistic to expect physical education teachers to markedly improve their diagnostic skills in post-graduate years. Also it is unlikely that training programs in the undergraduate years, no matter how expertly they are designed will resist erosion due to disuse. Perhaps intensive inservice rather than preservice programs represent a more promising way to reverse the trend. (Imwold & Hoffman, 1983,p. 154)

KNOWLEDGE CONCERNING THE PERFORMER AND THE PERFORMANCE OUTCOME

While it is generally agreed that a degree of analytic proficiency may be amassed from extensive analytic practice, little is actually known about the factors which discriminate between the novice and the expert. Information regarding the outcome of a movement may be one mechanism which expert instructors use to decipher the primary errors in a performance. Skrinar & Hoffman (1979), hypothesized that the experienced golf instructor's ability to recognize the occurrence of selected features of a golf swing performance would be enhanced by information concerning the outcome of the performance. Consequently, an experiment was designed in which subjects viewed filmed performances of the golf swing and were required to indicate the presence or absence of six critical positions or movements. For subjects in the experimental group, outcome information was provided in the form of a written statement noting the direction of the ball, the distance that it travelled, and the flight characteristics. Contrary to the experimenter's predictions, the provision of outcome information did not appear to significantly enhance analytic performance. It was possible that the analytic task was not difficult enough to require outcome information, or that the simulated context caused the teachers to adopt analytic strategies that differed from those used in natural settings. Similar difficulties were encountered by Armstrong & Hoffman (1979), in an attempt to determine the effect of providing observers with pre-response information (PCI) regarding the performer's level of skill, and post-response information (POI) on the flight characteristics of the ball. Subjects were assigned to one of four experimental groups each of which differed in the types of information they received. Each subject viewed filmed performances of the right hand tennis serve. Twelve common performance errors selected on the basis of a literature review and questionnaire responses from a group of 12 recognized tennis authorities, served as the criteria for an error detection test. The subjects' task was to first identify the landing location of the ball and then acknowledge the presence or absence of the twelve criterion errors for each example viewed. No evidence was produced to suggest that either the PCI or the POI condition strongly influenced the error detection accuracy of the experimental teachers. The authors suggested the time interval (2-3 seconds) separating the outcome information from the response may have diminished the subjects' ability to associate errors with the observed outcome and they concluded that further research was necessary.

OBSERVATIONAL STRATEGIES

> Non-instrumented observational procedures... are often biased, not so sensitive as a machine, require training, are slow and can be easily overloaded, are subject to error, their reliability is influenced by a variety of factors difficult to control such as the geo-social climate, and their sensitivity degrades with time. (Atha, 1975, p. 68)

In view of the virtual flood of visual information which occurs during the direct observation of movement it has been suggested that the development of observational strategies is the key to success in movement analysis. Certainly the view expressed by Atha (1975) suggests the necessity for the adoption of observation strategies. Bard, Fleury, Carriere, and Halle (1980) investigated the visual search patterns of gymnastics judges. As with the coach or teacher, judges of motor performances must visually capture and retain the performer's response. Intuitively, the ability to do this should be an important determinant in the decision making process. Previous research has indicated that the level of expertise influences the observer's visual search patterns. Bard & Fleury (1976), reported that there were significant differences among experienced and inexperienced basketball players on their location and number of eye fixations while performing a problem solving task involving projected slides depicting offensive basketball situations. In a similar experimental setup the eye fixations of gymnastic judges were recorded while viewing the performance of balance beam routines. Each judge was required to identify errors in the routines. The expert judges were found to have 27% fewer eye fixations than the novice judges, suggesting that the expert judges were more selective in their visual search strategies. Experts also exhibited a greater number of fixations on the upper body which was attributed to the fact that errors in highly skilled gymnasts were more likely to be detected through upper body movements. Additionally, the experts detected twice the number of errors in the performed routines. The authors concluded that the large quantity of trivial and redundant information that the novice judges collected increased the mental load and reduced the amount of time avaliable for diagnosis. "Indeed the expert judges have less fixations and concentrate on different parts of the gymnasts body. They seem to be more apt in making fine discriminations and more capable of ignoring trivial information" (Bard et al., 1980, p. 273).

The need for selective attention and the adoption of filtering strategies to prevent the brain from being bombarded by sensory input has also been supported by Whiting (1972). Whiting discussed possible theories as to how the selection of specific information is influenced by prior experience but offered no suggestions for training this ability.

Robb (1972) conceptualized a model which views the analyzer as an information processing system. In the process of task analysis, sensory information is received from both internal and external sources. Since all the information does not need to be processed the analyzer must somehow select the relevant bits, transform them, and send them to the memory storage system. The efficiency of making decisions is contingent upon the information which is stored in the memory system. A schematic of Robb's model is presented in Figure 5.

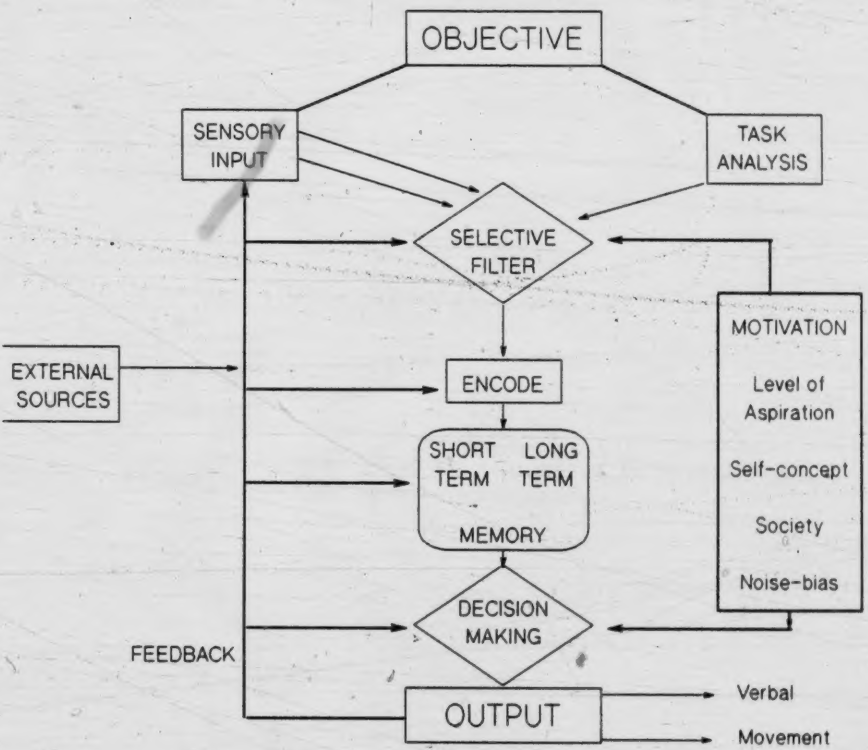


Figure 5. A Working Model of Information Processing (Adapted From Robb, 1972, p. 369)

Lewis (1980) suggested that scanning is patterned as a result of visual expectations that are previously formed. In this way the observer knows what to look for and which parts of the body are likely to provide the most information. In the Bard & Fleury (1976) study on basketball players, for example, the experts exhibited patterns of eye fixations which indicated their familiarity with the probabilities of the game (Lewis, 1980).

One of the few investigators to discuss visual search strategies in terms of their implications for training observational skills is Newston (1976). Newston first defined behavior perception as a feature monitoring process. The motor sequence is perceptually broken into parts as a result of perceiving changes in critical features. Newston continued by building a strong case for the careful identification of critical features prior to the observation process.

> Given the limited time capacity of short-term memory, a critical part of observer skill may be that of feature selection. That is, while many aspects of the ongoing event are changing some changes may be irrelevant. A skilled observer might just be one who selects the least redundant set of critical features for perceptual organization of the event, thus insuring maximal information gain from a given observational episode. (Newston, 1976, p. 120)

Newston also drew attention to the concept of predictive features. It is possible that the expert develops a series of features which act like critical feature indicators. The perception of the predictive features indicates that an important change is about to occur. Finally, Newston suggested that skilled observers may adopt monitoring priorities such that the appearance of a given feature causes the observer to cease monitoring that particular feature and start monitoring another .

The observer is required to extract relevant information from a performance and retain it in the short term visual memory banks long enough to diagnose and form remediation. Differences in the observer's ability to form mental images may, therefore, be related to differences in analytic ability. Housner (1984) examined the role of imaginal processing on the retention of visually presented sequential motoric stimuli. Although information regarding specific strategies was inconclusive, Housner determined that the subjects did employ imaginal processing strategies which operated in some way to facilitate short term retention of visually presented sequences of movement. Moody (1967) addressed imagery differences among women of varying levels of experience, interests, and abilities. The results indicated no significant differences on the subjects' abilities to recognize previous presented geometrics or motor performances. However, there was evidence to suggest that the teacher's skill in establishing a mental image of a performance may be enhanced by the attachment of a verbal label to a series of movements. For example, a series of labels was attached to basketball images, such as pivot right, dribble twice....(p. 446). Clearly, the ability to use this strategy would depend on the observer's personal dictionary of movement labels, presumably developed through extensive visual experience.

Imwold & Hoffman (1983), used a movement component recognition test to examine a theory that experienced observers adopt more efficient perceptual strategies by chunking information concerning the arrangment of the various body parts. As suspected, the experts performed significantly better. The relative superiority of the experts increased as the information load increased suggesting that experts were adopting a chunking strategy. Following an experiment on individual differences in imaging and perceiving, Sheehan (1966), stated that familiarity alone could not account for individual differences in imagery vividness. Individuals who were already classed as vivid imagers however, were found to form even more vivid images following practice. Unfortunately, there have been no reported attempts at training imagery strategies in physical education teachers or coaches.

ATTEMPTS TO TRAIN COMPETENCY IN MOVEMENT ANALYSIS

There has been very little research devoted to either the determination or development of experience necessary for enhancing competence in gross motor skill analysis. This is true not only for preservice and inservice teacher training programs but also for the coach with no formal physical education training. Kinesiologists and biomechanists have presumably believed that undergraduate courses in kinesiology and biomechanics develop a generic ability which teachers and coaches use to analyze movement. Unfortunately, these courses have been a "dry well " as an influence on teachers ability to analyze skills (Locke, 1972). In the article Towards a Pedagogical Kinesiology Hoffman (1977) argues that a teacher's ability to evaluate even the most fundamental skills are affected very little by undergraduate training. The weak influence of the undergraduate curriculum on analytic ability has been attributed primarily to a decrease in the amount of time devoted to qualitative techniques. Instead, quantitative techniques such as cinematography, electromyography and force measurement have been emphasized (Hay, 1973). While a quantitative emphasis may provide a strong theoretical basis for movement, information on research methodology, and knowledge concerning the contribution of various factors to high level performance, it does little to promote the teacher's or coach's ablilty to observe and diagnose errors in the motor performance of their students and athletes. Instructors of courses which have focused solely on quantitative techinques have failed to acknowledge the disparity between the analytic process used by the researcher to collect data about human movement and the analytic process used by the practitioner. "In the absence of preserved graphic records of the movement, the teacher conducts ex-post facto analyses of rapidly decaying precepts that are etched not on film but on the illusive territory of the minds eye" (Hoffman, 1974, p. 74).

The kinesiologist or biomechanist may argue that the traditional syllabus provides the student with an understanding of fundamental mechanical concepts and it is generally agreed that this knowledge is required throughout the analytic process. It is unlikely, however, that this knowledge alone will influence analytic skill. What is lacking in the traditional curriculum is a common thread which ties together all the important components of knowledge into a meaningful package. As far back as 1939, Huestler discussed the same problem encountered in the professional training of physical education teachers. Huestler queried the assumption that courses in anatomy, mechanics and kinesiology ensured the students had the ability to analyze skills in the gymnasium or on the field. She concluded that this assumption was highly unlikely since each course is a "pigeon hole" of its own.

Hoffman (1977), questions whether indeed a generic ability for analyzing sport performance can be developed without the extensive re-development of the undergraduate curriculum. Biscan & Hoffman (1976), conducted a study to determine whether physical education teachers and students possessed a special facility for comparative analytic skill. Their ability to analyze both a novel skill and a skill with which they were visually familiar was compared to the ability of classroom teachers. Differences in analytic ability were concluded to depend more on experience and extent of exposure to the visual stimuli than on the application of the general analytic scheme traditionally envisioned by the kinesiologist

(Biscan & Hoffman, 1976, p. 162). The presumption that analytic ability is acquired through a process of osmosis is unrealistic.

> Skill teachers and coaches can no more spontaneously evolve effective diagnostic strategies for gymnastic or volleyball instruction out of a melange of theoretical coursework offered up by the academics, (most of whom are neither interested nor knowledgable in the kind of clinical decision-making required in pedagogy) than medical students can spontaneously evolve an effective method of diagnosing encephalitis from a basic course in anatomy and physiology. (Hoffman, 1982, p. 41)

Another approach to skill analysis training has centered around the visual presentation and recognition of common performance errors. The premise for this type of training has been that an awareness of common performance errors coupled with a visual experience facilitates the observer's ability to identify errors in the analysis of a real performance. Clearly, the implementation of such a training procedure rests on the development of organised taxonomies of common performance errors. The recommendation for carefully constucted of taxonomies of performance errors has been a frequent one in the literature (Berg, 1975; Hoffman, 1976; Vanderbeck, 1977). Berg (1975), deemed the availability of such taxonomies to be of particular importance to the new teacher. "An awareness of errors commonly found in different movement patterns, a description of how they affect performance and suggestions on how to overcome the errors would provide physical educators with a tangible means of organizing skill analysis" (Berg 1975, p. 44).

Several investigators have incorporated this approach in efforts to train competence in skill analysis. Ulrich (1976), developed a golf swing error detection and correction (GSEDC) module in an attempt to improve physical education students' ability to analyze the golf swing. The objectives of the module were to teach the students to systematically consider awareness, detection, identification, and analysis and correction of errors through a comparative analytic approach. The treatment included self-paced and guided instructional materials along with visual presentations of correct and incorrect performances of the golf swing shown simultaneously on a split screen. The module was divided into two phases; address position errors and swing movement errors. Performance errors were selected from a review of the literature, analysis of videotaped beginners performing the swing, and the observations of various instructors. During the implementation of the program a split screen as well as still slides depicting both correct and staged incorrect performances were used. Although no data were collected to support the efficacy of the program, Ulrich concluded that the GSEDC module held great promise for improving the analytic proficiency of beginners. Also noted was the module's potential for facilitating the transfer of a systematic approach to skill analysis. No information was provided on the actual effectiveness of specific training strategies. The effectiveness of using staged performances should be questioned. "Staged simulation of an error by a skilled performer tends to isolate the error in the visual display presented. However, errors tend not to be isolated in real life learning situations where errors of beginners often occur simultaneously and in a variety of forms" (Gangstead, 1982, p. 30).

An instructional unit comprised of two films and their narratives was developed by to deal with error identification in the analysis of swimming skills (Vanderbeck (1977). Characteristics of the unit were: a recommended system for observing performance, demonstration of performance errors, comparison of errors with efficient performances, and opportunity for repeated viewing. Performance errors were derived from a literature search. An opinionnaire completed by Master and Experienced teachers was used to evaluate the general usefulness, comprehensiveness and accuracy of the materials. Vanderbeck concluded that the teachers expressed positive attitudes towards the unit. Suggestions for improvement included an increased number of common errors, causative errors, and error patterns. As with the Ulrich (1975) program, Vanderbeck failed to provide empirical support for the use of a performance error approach as a basis for skill analysis training. While teachers may have reacted positively to the instructional unit, there is no indication as to whether they were better able to analyze swimming skill as a result.

Hoffman & Armstrong (1975) designed a study to gather preliminary data concerning the extent to which competency in performance error identification could be developed through short term training experiences. In addition, the investigators were interested in examining the relationship between visual imagery and competence in error identification.

Eighty-six preservice physical education students were randomly assigned to one of four groups: Correct (CR); Correct-verbal (CV); Correct-error (CE); and Control (C). CR subjects were provided with the opportunity to view multiple replays in which the filmed performances demonstrated examples which conformed to a list of defined criteria. Subjects in CV were provided with training that focused on the presentation of verbal descriptors of the performance criteria. Multiple replays of examples of both correct performances and performances that did not conform to the criteria were provided to subjects in CE. Finally, subjects in C were not provided with any verbal or visual training.

The results of the Hoffman & Armstrong investigation highlighted the difficulty that is associated with the development of error identification during short term experiences. The results provided no evidence to suggest that a generic visual image control factor was related to competence in detecting performance errors. The authors, did however, question the ability of the employed imagery test to detect the types of variations in performance imagery that may have existed. It is interesting to note that the poorer performance of the CR group on performance error identification was determined to be a result of mistaking instances of incorrect performance for examples of correct performance.

> Assuming that demonstration of correct technique is the dominant training approach used in institutions, the potential for this to create sets to see performance as correct deserves further investigation. (Hoffman & Armstrong, 1975, p. 213)

Hoffman (1977), in his paper Towards a Pedagogical Kinesiology, takes a strong stance on the benefits of learning and recognizing common performance errors. Furthermore, he views the lack of catelogued responses as a result of indifference to the merits of the approach rather than an ability to generate such lists.

> Pedagogical kinesiology does not accept the traditional proposition that physical education teachers do or can differentiate correct movement responses on the basis of their knowledge of mechanical principles....In pedagogical kinesiology, movement responses are evaluated in relation to qualitative criteria specific to the task being analyzed.(Hoffman, 1977, p. 44)

By contrast, Norman (1975) stated that many of the difficulties encounterd by coaches in the past have arisen from attempts to memorize staggering amounts of specific performance details. "Using only a clearly defined set of qualitative criteria to analyze a skill perfomance emphasizes memorization over an understanding of the causes of errors in the movement" (Norman, 1975, p. 50). The approach fails to account for idiosyncracies in performances, errors which are symptoms of larger errors, or the fact that errors seldom occur in isolation. Attempts to train analytic ability strictly on the basis of a set of common performance criteria may prove to be useless.

To date, the most wide-spread application of a structured skill analysis training program for Canadian coaches has been the skill analysis portion of the National Coaches Certification Program (NCCP). The NCCP is designed to meet the needs of practicing coaches, whether they are beginner or experienced coaches and regardless of their level of education or sports background. The program is structured on five levels and presents coaches with information on the theoretical, technical, and practical aspects of coaching. The theory courses are provided by the provincial/territorial governments across the country and relate detailed information on such topics as skill analysis, exercise physiology, nutrition, leadership, training and conditioning. Associated with each instructional unit is a series of objectives, group tasks, self-paced activities, examples and visual aids. The amount of time devoted to any one area varies from level to level as well as between topics.

The skill analysis sessions are based on the understanding of eight basic biomechanical principles. The principles are first presented and discussed, then followed by examples of their application to the detection and correction of performance errors. In Biomechanics for the Community Coach, Norman (1975) discusses the rationale and merits of the NCCP program. Regarded as key to the future success of the program is the fact that the memorization of performance details is replaced by the understanding and application of fundamental biomechanical principles. "With guidance they (the coaches) then learn to use them to detect errors and suggest corrections with a biomechanical justification" (Norman, 1975, p. 49).

While the program represents an excellent attempt to facilitate the coaches' ability to analyze skills, many questions remain unanswered. Does an understanding of eight basic principles promote a general analytic competency? Are the learning activities effective? Are coaches able to transfer the application of the principles to their own specific sports? To the knowledge of the author there have been no formal attempts to assess the effectiveness of the NCCP program.

As previously mentioned, Hensley (1983) also supported an approach to qualitative analysis which is based on the identification of relevant biomechanical constructs.

> Therein lies the first step in an effective measurement strategy - - the identification of the basic biomechanical principles which affect a particular movement and thus need to measured. (Hensley, 1983, p. 21)

According to Hensley the approach is fundamental to the University of Northern Iowa's Biomechanical Profile Analysis System. Unfortunately no information is currently available on the details of this system's implementation.

Research on training programs which have addressed skill analysis in its entirety, and through a packaged approach, is limited to four major studies. Triggered by the lack of a systematic attempt to develop feedback skills for promoting motor skill acquisition in preservice physical education teachers, Armstrong & Imwold (1982), established a pilot program to develop competence in observation and movement analysis. The investigators initially established that the provision of feedback required four subcomponents;

1. Observation of a response to determine salient characteristics.
2. Differentiation between correct and incorrect characteristics.
3. Determination of response modification.
4. Translation of information into a readily understood format.

A closer examination of the problem indicated a need to link the observation and analysis skills together by approaching the feedback process in its entirety. Consequently, a six stage analysis model was developed and presented to a group of preservice physical education teachers with completed course work in exercise physiology, biomechanics and motor learning. The analysis model is presented in Figure 6.

The pilot program was divided into four phases, each with a set of specific goals, instruction and learning activities. A variety of techniques such as micro-teaching, selfpaced activities and protocol materials were used to enhance the learning process. Subjects were guided through the four phases for four hours a week of class time over five weeks. Phase one focused on an analysis of the students' own instructional behaviors. The model was introduced in the second phase of instruction. Phase three was designed to provide students with the fundamental movement patterns of selected sports skills while simultaneosly refining their use of the analysis model. Finally, the fourth phase of instruction attempted to broaden the scope of the student's ability to apply the model.

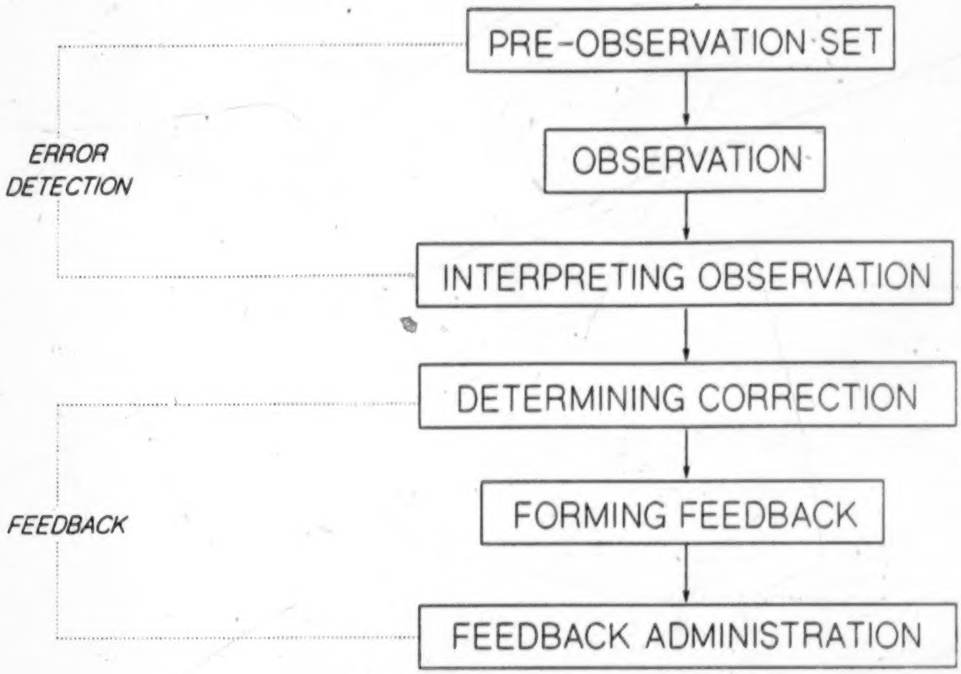


Figure 6. Movement Analysis Model (Adapted From Armstrong & Imwold, 1982, p. 2)

While no attempt to empirically test the program was made, the investigators reported that the feedback elicited following implementation of the program was superior to that elicited initially. Furthermore, it was noted that all participants became thoroughly sensitized to the process involved in the acquisition of feedback information. Unfortunately the lack of specific information regarding the type and magnitude of gains makes it difficult to assess either the program's time and cost effectiveness or the possibility of applying the analysis model to real analysis situations.

Gangstead (1982) examined the effects of instruction guided by the use of an observational model on the analytic proficiency of undergraduate physical education majors. A pre-test/post-test, experimental versus control group design was employed. The experimental group participated in three one hour sessions per week for eight weeks of qualitative instruction. Subjects were instructed extensively in the use of an observation model developed by Davis (1981). An outline of this model is presented in Figure 7. The main goal of the instruction was to develop the skills necessary for the three components of the analytic process discussed by Hoffman (1974); observation, evaluation, and diagnosis. In addition, Gangstead was motivated by the prospect of separating perceptual error from diagnostic error. Class instruction consisted of visual and verbal training in the observation of videotaped and live performances of a variety of sport skills. The instructor presented models of both correct and incorrect performances. Additionally, a variety of self-paced activities was included in the program. Subjects in the control group participated in the pre-test and post-test assessment but received no formalized instruction. The Utah Skill Analysis Test , developed by Beveridge & Gangstead (1982) was used to assess performance levels of analytic proficiency and its two subcomponent measures, perceptual and diagnostic proficiency. The instrument contained a series of videotaped performances of actual learners performing selected motor skills. The recorded trials exhibited a full range of specified performance errors.

Body Components	TEMPORAL PHASING		
	Preparation	Action	Follow Through
Path of Hub			
Body Weight			
Trunk Action			
Head Action			
Leg Action			
Arm Action			
Impact/Release			

Figure 7. Observational Model (Adapted From Gangstead & Beveridge, 1984, p. 62)

Gangstead found that a significant difference existed between the experimental and control group on the post-test measures of both perceptual and diagnostic proficiency. In support of previous observations, no relationship was determined to exist between the two analytic components in the pre-treatment assessment of either the control or experimental group. "Evidently these two tasks are independent of each other. Yet it is important to note that logically, correct performance on both tasks must occur for the analyst to be able to provide effective feedback to the learner regarding specific aspects of performance on a motor skill" (Gangstead, 1982, p. 64). Gangstead concluded that the improved performance of the experimental group was a result of observational and analytic experience gained through the programs instruction. The program represents a milestone in the area of skill analysis. A systematic approach to movement analysis emphasizing both perceptual and diagnostic components has been suggested in the literature but few have attempted to implement and assess it. The results of the study should provide impetus to those concerned with developing the analytic skills of both preservice and inservice teachers and coaches.

The golf swing error detection and correction (GSECD) module mentioned earlier in the chapter, was applied over a three year period in an attempt to improve the analytic proficiency of students enrolled in a physical education golf activity course (Ulrich, 1977). Despite the fact the package was geared towards the analysis of a specific skill it used an approach which could be adapted for the analysis of other skills. Based on the theoretical basis of the program, favorable student reactions, and the subjective observations of the instructor, Ulrich concluded the approach held great potential. Of particular interest was the inclusion of a selfpaced study unit. If, as has been suggested, analytic ability can not be developed effectively in very short-time periods then the development of self-paced programs hold great promise. Prior to the adoption of such programs, methods for monitoring and assessing the implementation of the self-paced treatment components need to be developed.

More recently, Kniffen (1985) attempted to train analysis skills using individualized videotape instruction. The purpose of the study was to improve the ability of undergraduate majors to verbally identify critical elements of select sport skills and visually discriminate those elements as correct or incorrect.

Four, 10 minute color videotapes were produced to train teachers to discriminate correct and incorrect response characteristics for a given skill. Each tape included a rationale for the sport skill, demonstration of the skill performed both correctly and incorrectly, slow motion and stop action analysis of each critical element, practice activities for the identification of the critical elements and the performance errors, and a review of the five most significant critical elements.

Kniffen incorporated a single subject mulitple baseline research design to study the way in which each individual analyzed each of four sport skills. Under testing conditions the subjects in the study viewed three instant replays of each videotaped performance. Within a 2 1/2 minute time limit, the subjects had to list the five most important critical elements and visually discriminate those elements as correct or incorrect. A generalization phase of the study was undertaken to test the subjects ability to transfer what was learned in the laboratory setting to a real life setting.

The results of the testing sessions were displayed graphically and changes between the baseline and intervention conditions were visually analyzed for observable changes. Kniffen determined that the ability to identify critical elements and visually discriminate the elements as correct or incorrect was initially very poor for all of the subjects on all of the skills. The subjects significantly improved their recall of the critical elements, and the discrimination between correct and incorrect elements, following the intervention. In addition, sport skill analysis proficiency acquired through individualized videotape instruction was successfully generalized to authentic student execution of skills in a real school setting. The subjects involved in the study reported they were satisfied with the testing conditions, procedures and results.

Kniffen's study is most interesting for a number of reasons. First, Kniffen determined that the ability to analyze each sport skill improved only following intervention on that particular skill. Specificity of sport analysis skills was supported by a number of investigators previously reported. Secondly, the investigation represents not only one of the few attempts to empirically evaluate the effects of a skill analysis training program, but also one of the few studies reported to have applied intervention techniques as a method of changing teacher analysis behaviors. Finally, the findings concerning the generalization of the change in analysis abilities from the simulated context to the real life setting holds important implications for future discussions related to external validity.

The discussion in previously cited studies which have dealt with the development of measurement systems designed to assess competency in skill analysis have been decidedly brief. Typically, authors have stated the instruments and methods which have been used to collect the data, skimmed over measures of reliability and validity, and provided little or no justification for their choices. In one of the rare attempts to address these concerns, Hoffman (1976) presented a paper on competency-based training in skill analysis. The paper begins with consideration of the context in which assessment of skill analysis takes place. Hoffman argues that written examinations in which both the stimulus and response are written statements, are representative of the symbolic context and fail to authentically test analytic proficiency. They provide only a measure of theoretical comprehension. By contrast the ideal context, the work or real-life setting, resists control over both the learner's responses and the construction of valid measurement criteria.

> The most appropriate context for assessment would appear to be a simulated context in which the stimuli presented consist of prepared, visual samples of learners performances, and in which the responses elicited are written or oral indicators of the trainees competency in identifying errors in the samples displayed.
> (Hoffman, 1976, p. 6)

Within the simulated context careful attention must be devoted to two components of the measurement system; the visual materials, and the learner's response system. The following is a summary of the suggestions which Hoffman makes concerning the design and implementation of these two components.

1. The response system must allow for distinction between perceptual and diagnostic abilities.
2. The visual medium must closely approximate real conditions. 8mm film was recommended over videotape due to the superior image quality and the potential for

frame by frame analysis.

3. The visual stimulus should offer real not simulated learner responses.
4. Only fundamental performance errors should be depicted.
5. Attention must be given to the frequency with which certain errors are presented in the stimulus.
6. Errors depicted in the test film need to be validated either by using a frame by frame analysis or by inter-observer reliability measures.
7. The response system must be capable of eliciting either oral or written responses which reflect analytic proficieny.

SUMMARY

The review of the literature dealing with approaches to the process of skill analysis, illustrated a past tendency of theorists to deal primarily with just one or two of the components of skill analysis. The pre-observation and observation components were most frequently addressed. In general, the authors of these approaches advocated a conceptual analysis of the skill which included; identification of the goal or movement objective, movement simplification, determination of mechanical constructs, and identification of the critical features. The identification of the critical features was considered essential to the ability to analyze. A second phase in the pre-observation component addressed the development of an observational plan. In the development of an observational plan consideration was given to the factors which were most likely to influence the ability to observe: organization, and the principle of positioning.

Several authors supported the notion of teaching observation skills generically. This was based on the contention that observation demands accurate perception and selection of visual input. In spite of the strong stance for observational training only one report of a training approach to the observational component was reviewed. By contrast a number of different instruments for recording observations were posed. Response formats ranged from the degree of adherence to mechanical constructs to the presence or absence of critical features. An excellent approach proposed by Hoffman (1980) for the diagnosis and remediation components of skill analysis was discussed. The approach focused on the recognition of the nature and extent of discrepancies between an observed learner's response and a desired response. This was followed by the identification of causes and the formation of a remediation. The work of Arend & Higgins (1976) has been particularly influential. Their skill analysis strategy represented a rare attempt to unify, organize, and integrate analysis procedures, in a holistic approach.

Despite the many factors which have been cited to influence analytic ablility, research concerning these factors has been limited in both quantity and quality. However, on the basis of the reviewed literature the following statements concerning factors affecting analytic ablility appear justified;

1. Kinesthetic experience with a motor skill may not influence one's ability to analyze the same skill.
2. Extensive experience with teaching or coaching specific skills appears to enhance analytic ability.
3. Supplementary information regarding the performer's competency or the performance outcome does not appear to strongly influence the observers analytic ability.
4. There is evidence to suggest that expert observers adopt monitoring and filtering strategies to extract the relevant information from the performance of a motor task.
5. The ability to form mental images may be an important determinant in analytic ability.
6. Whether the ability to form mental images is related to strategies such as the attachment of verbal labels or merely the result of visual familiarity remains unclear.
7. The identification of critical features and predictive features may act to facilitate perceptual organization.
8. Visual search strategies may be developed as a result of visual familiarity with the probabilities of various movements.
9. There are data to suggest that analytic ability erodes through disuse supporting the

development of inservice training programs.

The final areas of research introduced in this section were concerned with attempts to train competency in skill analysis. Statements concerning the weak influence that undergraduate courses in kinesiology and biomechanics have exerted on analytic proficiency were particularly evident in the reviewed literature. This has been attributed first to an increased emphasis on quantitative techniques. Secondly, it has been attributed to the lack of a successful attempt at synthesizing the information presented in the traditional curriculum. There have been several attempts to train competency based on the presentation of common performance errors, however only in the study by Hoffman & Armstrong (1975) was there any evidence to support the effectiveness of this approach. A skill analysis training procedure based on the understanding of fundamental biomechanical principles could prove to be a more promising approach. A number of packaged training programs were reviewed and discussed. Although a paucity of empirical data exists these programs have provided great impetus for the current research. Finally, a discussion on the development of measurement systems designed to assess analysis skills in the simulated context was presented.

CHANGING TEACHER BEHAVIOR IN PHYSICAL EDUCATION THROUGH INTERVENTION TECHNIQUES

Over the past decade there has been an increased emphasis on the development of strategies designed to improve specific behaviors or skills in physical education teachers. More recently, research has relied heavily on packaged intervention techniques.

> An intervention is a planned intrusion into the life or environment of an individual, couple, family, or other target unit that is intended to bring about beneficial changes for the individuals or others involved. (Thomas, 1984, p. 29)

The purpose of this section is twofold. First, a general summary of the use of intervention techniques in the physical education setting will be presented. This will be followed by a more detailed discussion on design and data evaluation.

Experimental studies using intervention procedures focus upon the teacher behavior as the dependent variable and the intervention as the independent variable. The objective of a teacher intervention procedure is to help teachers improve their teaching skills (Locke, Graber & Dodds, 1984). By far the majority of studies which have used intervention techniques to change teacher behaviors has been part of a series completed at Ohio State University using a behavior analysis model. Siedentop (1982), the individual responsible for initiating these studies has taken a strong stance as interventionist. "If you really want to understand something, try to change it" (Siedentop, 1982, p. 48). Siedentop discusses the research paradigm as one in which the researcher is required to be of service to the practitioner. The systematic application of interventions may also serve to establish a theoretical base on experimental research in the sport and physical education setting and provide a basis for the eventual technology of teaching and coaching.

Intervention used in the physical education setting is typically carried out in a program format. Format presentations have ranged from small workshops to extended courses. Regardless of the format a package of intervention techniques is applied to one or more target behaviors over a period of time. Therefore, the first step in the procedure is to define appropriate target behaviors. A single behavior or category of behaviors must be capable of being measured reliably, recognised by preservice and inservice teachers as being significant to the teaching learning process and amenable to change in a certain direction (Siedentop, 1981). Poorly defined behaviors are often judged using unreliable methods of measurement and are highly susceptible to the personal bias of the observer. Furthermore undefined behaviors do not permit the teacher to set realistic goals and effect systematic changes.

The implementation of intervention procedures generally involves four major phases; recording and graphing of data, goal setting, the intervention package, and the provision of feedback. Initially the target behavior or performance is sytematically observed or measured. The data which are collected are used to form a baseline and to set the target goals for the procedure. Following the establishment of a baseline, the intervention techniques are implemented. Thomas (1984) stated that the implementation of an intervention requires; (a) introduction of the intervention to the client, (b) acheivement of appropriate program involvement, (c) monitoring of target behaviors, and (d) re-evaluation and adjustment of the intervention program to sustain the change (Thomas, 1984, p. 72). The actual schedule of intervention is contingent upon the experimental design. Similarly, the frequency and number of sessions as well as the context in which the intervention is presented is dependent on the needs and objectives of the program.

In the use of single subject designs, the efficacy of the relationship between the intervention and the resulting change in behaviors is frequently determined by a visual analysis of the data from baseline to intervention conditions. The criteria by which the significance of this relationship is judged is dictated by a number of factors which will be discussed later in this section.

Intervention packages which have been used in the physical education environment have usually incorporated a variety of components including; definitions, goals and objectives, learning resources, instructions, assessment procedures, and learning activites. Other components such as self-paced learning activites, micro-teaching techniques, protocol materials and others have also been used with much success.

In conjunction with the use of packaged materials plans must be made for the provision of feedback. Feedback provides the learner with an indication of their progress and facilitates the change process. Techniques for administering feedback commonly include graphic feedback, verbal feedback reinforcement, cueing, verbal mediation, and modelling. McKenzie (1981) examined the effectiveness of feedback and goalsetting on the modification, transfer and maintainance of the verbal behaviors of experienced physical educaton teachers. Following a baseline condition of five days, the intervention was implemented. Intervention consisted of providing verbal feedback on the targeted behaviors and helping the subjects set goals for future rates of behavior. The significant increase in the occurrence of all three verbal behaviors was attributed to the packaged intervention, however the effects of the interventions did not transfer to a non-training setting. The author pointed out the implications of these findings on the development of inservice training.

Researchers using packaged intervention methods have frequently used a modular approach for the program. Each module consists of its own set of goals, instructions, and learning materials. Dodds (1975) studied the effects of a competency based supervision model using peer assessment procedures on selected verbal behavior patterns of student teachers in physical education. The intervention package was arranged in four competency based modules; observational, instructional, management, and interpersonal. Each module covered a category of targeted behaviors. Package material included definitions, goals, resources, practice suggestions and various forms of feedback. The intervention modules were successful in changing the majority of the teacher behaviors.

A vast majority of the experimental research on changing physical education teachers behaviors using intervention techniques have targeted the provision of feedback and interpersonal interactions (Boehm, 1974; Cramer, 1978; Darst, 1974; Darst & Steeves, 1980, Dessecker, 1974; Dodds, 1979; Graham, 1973; Hustlar, 1977; Mckenzie, 1981; Nelson, 1977; Rife, 1974; Wurzer, 1982;). In only two of the studies reviewed was there any mention of using intervention techniques to train competency in skill analysis. Morrison (1982) developed an instructional videotape unit to aid preservice and inservice elementary school teachers in analyzing selected fundamental movement patterns. The intervention techniques included correction and teaching cues derived from fundamental movement patterns. Unfortunately no information is provided on the development or implementation of the intervention. No significant results were found.

Kniffen (1985) also examined the effects of an instructional videotape on physical education majors on the ability to analyze selected sport skills. Intervention techniques were employed with a single-subject multiple baseline research design with probes. The independent variables in the study were four instructional videotapes. The verbal identification of the critical elements and visual discrimination of the correct and incorrect elements constituted the dependent variable. Test videotapes were constructed of 56 different performances of four skills, placed on the test tapes to fit a single subject design. Each performance measure was referred to as a probe. The baseline phase of the study measured the subject's ability to identify critical elements and discriminate those elements as correct or incorrect. The intervention phase measured the subject's ability to analyze skills following the viewing of the instructional videotapes. The data were visually analyzed for observable changes in the magnitude of the change in behavior between the baseline data and the corresponding intervention/generalization data. Kniffin concluded that videotape instruction was an effective pedagogical tool to facilitate qualitative sport skill analysis and that the ability to recall critical features aids selective attention to those features of a sport skill that require discrimination.

Despite the recent upsurge in interest on the use of intervention techniques for experimental research on teaching in the physical education setting, researchers have consistently neglected certain aspects of the methodology. With the exception of a few studies, the authors have failed to explain the rationale for selecting the intervention treatment components or even how the intervention package was developed. Similarly, the monitoring procedures used to gauge the implementation of the intervention have been rarely mentioned. If the investigators did not monitor the implementation conclusions may not be drawn concerning the effects of the intervention on the target behaviors. "When the intervention consists of behaviors in natural settings, the investigator has no assurance that the intervention is carried out correctly, or indeed is even implemented at all. This situation is to be contrasted with laboratory experiments in which the intervention can be implemented by reading instructions or playing an audio or video tape recorder and in which standardization of the intervention can be more readily assured. When behavior of individuals in contact with the client is the independent variable, it is especially important to gather data to insure the intervention is carried out."(Kazdin, 1978, p. 634) One of the difficulties with a packaged intervention program is the inability of the researcher to sort out the effects of individual components strictly on the basis of the results. The overall effectiveness of a treatment program conceivably could be reduced by the inclusion of a weak component or strategy. One way to help prevent this difficulty is to examine the strengths of the components separately. In any case, the implementation of the entire treatment should be carefully monitored to indicate the existence of weak components or components which are not properly implemented. Finally, a general lack of concern for the overall appraisal of the programs was evident. In most cases the authors stated the results of the data analysis but failed to consider the impact of other variables or the time and cost effectiveness.

Prior to the final review of the data design and evaluation techniques used to examine the effects of interventions in the physical education domain, a brief overview of descriptive analytic research is considered necessary.

Descriptive analytic research has been posed as a method designed to examine and explicate the teaching process and which clearly has implications with regards to understanding the effects of interventions.

> In the evaluation oriented world of education, descriptive-analytic research on teaching is regarded by many as a curiosity. It does not attempt to prove the superiority of one teaching method over another. Nor does it attempt to identify good and bad teachers. It does not even attempt to offer evidence in support of principles of effective teaching...it focuses on the rather modest goal of accurately describing real-world events in the classroom (or gymnasium) and analyzing these events in a way that leads to a better understanding of what transpired.
> (Anderson, 1971, p. 1)

Anderson (1971) states that descriptive analytic research has two basic characteristics. First, an accurate description and record of the events that transpire are maintained. Typically, data has been collected using trained observers or recording devices, however, other systems for collecting and classifying the events of interest are possible. Secondly, the results are analyzed in such a way as to gain an understanding of what exactly has occurred. Often the frequency of responses are tabulated and the relationships and patterns examined.

Descriptive analytic research lends itself as an effective aid to the evaluation of the preliminary testing of a training program designed to promote skill analysis competency. Reactions to specific events can be systematically collected and classified. The descriptive records that emerge can be examined for relationships and patterns, and the results used to refine the program intervention. In addition, the results from the descriptive analysis may be used as a basis for the development and implementation of experimental evaluations.

DESIGN AND DATA EVALUATION

Investigations involving the evaluation of interventions with preservice and inservice physical education teachers have been employed both between-group and single-subject paradigms. The most frequently used and most powerful between-group design has been the pretest-posttest control group design. Specific designs which were used under the single-subject paradigm were: the reversal, multiple baseline and the multi-element baseline design. However, few of the designs which have been reported are applicable to a program which attempts to promote competency in skill analysis. The purpose of this final section of the literature review is to first identify and examine the designs which are considered central to the evaluation of a skill analysis training program. Additionally, some examples of the design applications, and the advantages and disadvantages which are inherent in their utilization, will be provided. The second part of this section will be devoted to a discussion on the methods which have been used to evaluate the data.

In between-group designs subjects are assigned either to experimental conditions or control conditions. The design seeks to demonstrate group differences following manipulation of the independent variables. Data are subjected to statistical evaluation with the focus on mean differences instead of the behavior of individuals (Kazdin, 1973, p. 518). The effects of the intervention are evaluated by comparisons between different groups. Among the advantages of between groups designs is the allowance for larger and randomly selected samples, as well as the comparison between one or more interventions with separate control conditions (Thomas, 1984). Unfortunately, group averages yield little information concerning treatment effects on individuals. The results tend to focus attention away from the effects of the intervention on the dependent variable. Large inter-subject variability, typical of both preservice and inservice educators, may further reduce the significance of group differences.

> As a rule courses in experimental design emphasize sampling, control groups, and inferential statistics. All are particularly inappropriate to the practitioner interested in improving the quality of services provided to the individual. (Birnbrauer,74, p. 191)

The field of teaching and coaching in physical education lends itself to the use of single-case designs. Traditional methods of measurement and research designs are of limited use since we are interested most in examining the functional relationships between individuals and experimental conditions.

> What we are after in education, in the final analysis, is a science of the behaving individual whether he or she is behaving in the classroom or on the playing field.

> And we are almost always interested in the behaving organism as individual rather than as an average. (Siedentop, 1982, p. 49)

The majority of single-subject investigations have relied on the multiple baseline design. The design has proven to be very useful in achieving internal validity without reversing the behavior of interest back to pre-intervention levels. This is of particular importance to the analysis of intervention effects on the training of competence in academic or motor skills. Effecting a reversal in that situation is rarely possible or desirable (Kazdin, 1973). In the multiple-baseline design data may be collected across behaviors, individuals, or situations. For all of the variations, the effect of the intervention is demonstrated by showing that a behavior change accompanies the introduction of the independent variable at different points in time. In regard to the criterion of external validity or generalizability, questions are frequently raised concerning the representativeness of findings from single-case experiments. With the single-case design, the possibility for generalizing results is determined not by probability statistics, but by either direct or systematic replication. Direct replication involves repetition of the given experiment by the same investigator. Systematic replication involves extensive replication in different settings with different subjects and different target behaviors (Thomas, 1984).

In 1973, Hughley conducted an experimental analysis of teaching behavior during the student teaching experience. He was primarily interested in examining the extent to which a supervision package was effective in evoking selected teacher behaviors. Hughley (1973) analyzed the behavior rates of four student teachers before, and during intervention, using a multiple-baseline design. It was concluded that directed information feedback was effective in producing teacher behavior changes in student teachers. This experiment was the first in what became a series of related studies at The Ohio State University in the analysis and control of teaching behavior utilising single-subject strategies and the multiple baseline design (Siedentop, 1982). Three generations of researchers using the multiple baseline design at The Ohio Sate University have established external validity through systematic replication.

A multiple baseline across behaviors, for one or more subjects, has been the single-case design most frequently employed (Boehm, 1974; Cramer, 1977; Darst, 1976; Darst

& Steeves, 1980; Dessecker, 1975; Dodds, 1975; Hart, 1984; Hustlar, 1976; McKenzie,1981; Rife,1974; Wurzer,1982). In this version of the design, baseline data for two or more behaviors is collected for a subject or group of subjects. After all the baseline measures have stabilized, the intervention procedure is applied to just one of the behaviors. The objective is to change only the behavior to which the intervention is applied. Ideally, the other behaviors (or perfomance levels) should remain at baseline levels until the intervention is applied sequentially to each of them. A causal relationship between the intervention and the behavior is demonstrated if each behavior, or the frequency of each behavior, changes when, and only when, the intervention is introduced (Kazdin, 1978). For example, McKenzie (1981) used a multiplebaseline design across behaviors to examine the effectiveness of a simple feedback and goalsetting intervention on the instructional behaviors of an experienced physical education teacher. Baseline data were gathered during a five day baseline period to examine the natural rates of a variety of teaching behaviors. A simple intervention procedure was used in an attempt to change three targeted verbal behaviors. The schedule for implementing the intervention procedures was after day five for the first behavior, after day seven for the second behavior, and after day nine for the third behavior.

> The conclusion that changes in the three behaviors were attributable to the intervention procedure and not to other factors was established by the use of a multiple baseline design involving the application of the intervention to different behaviors at different times." (McKenzie, 1981, p. 54)

Difficulties with the across behavior design may arise if any of the behaviors of interest are interrelated or interdependent. In the case of correlation among the dependent variables the intervention implemented on one of the behaviors may result in a change in the baseline conditions of the other behaviors. Subsequent decisions concerning the evaluation of the relationship between the independent and dependent variables will not be valid. In the case of the previous example, McKenzie targeted three verbal behaviors ; "OK'S", the use of first names, and the provision of positive feedback statements. Clearly, these behaviors are independent of one another and thus would not impose constraints on this particular design.

As previously mentioned, the only study reviewed which attempted to evaluate the efficacy of a relationship between a training program and improvements in analytic ability using a single-subject design was conducted by Kniffen (1985). Kniffen employed a multiplebaseline across subject design with probes to examine the ability of physical education students to detect performance errors. Murphy & Bryan (1980) defined a probe to be an infrequently scheduled, short-duration change in the conditions at various points during an investigation (p. 329). By applying that definition, probes may be used in conjunction with a multiplebaseline design to assess the generality of behavior across responses or subjects (Kazdin, 1982). For example, in the Kniffen (1985) study, probes were used to evaluate the degree to which the analysis skills learned in the simulated context transfered to a real analysis situation. The results suggested that the design was effective in establishing the effects of the intervention. Multiple-probe evaluation designs have also been employed in situations where an extended baseline is either impractical, impossible or reactive (Horner & Baer, 1978; Kazdin, 1982; Murphey & Bryan, 1980). "Reactivity can occur when an intervention must be powerful enough to not only overcome any extinction, boredom, fatigue, increased competing behavior, or other undesirable effects introduced through the use of extended baselines" (Murphey & Bryan, 1980, p. 330). An important consideration for the use of the multiple-probe technique is the stability of the baseline. Horner & Baer (1978) suggested that the design was particularly suited to situations where the behavior was expected to improve only after some type of instruction or intervention. The likelihood of a stable baseline would be greater in those cases.

The changing-criterion design is a design which provides a procedure for demonstrating a relationship between an intervention and a behavior subjected to progressive changes in the performance criterion (Hartmann & Hall, 1976; Horner & Baer, 1978; Kazdin, 1982; Kratochwill, 1978). The design requires a baseline phase followed by the implementation of a treatment to each of a series of treatment phases. Each intervention is associated with a stepwise change in the criterion measure. The only studies which were found to employ this design were from the applied behavior domain. In each of these studies, the investigator used a changing criterion design to evaluate the stepwise changes in the rate of a particular behavior such as the rate of smoking, or eating. A number of the authors have however, mentioned the potential for assessing stepwise changes in the quality or accuracy of skills and behaviors. As with the multiple-baseline design it is also possible to combine probe techniques with a changing-criterion design to provide both an accurate and cost effective method of evaluation. The following is a summary of the guidelines which have been suggested for combining the changing-criterion design with probes (Hartmann & Hall, 1976; Horner & Baer, 1978; Kazdin, 1982; Kratochwill, 1978).

1. An initial baseline probe session should be conducted on each step in the training sequence.
2. An additional probe session should be conducted on each of the remaining steps immediately following the achievement of a criterion.
3. A series of probes should be conducted prior to the introduction of the intervention to each step. The series should increase by at least one session each time and serve to form a "true baseline".
4. The treatment phases should vary in length so as not to have natural changes in the target skill occurring in synchrony with the criterion changes.
5. The number and magnitude of criterion shifts must be carefully considered.

DATA EVALUATION

Data evaluation consists of the methods which are used to draw conclusions about relationships between the independent and dependent variables. The purpose of this section is to present the data evaluation techniques most frequently reported in the single-subject intervention literature. A detailed description of the many analysis techniques which have been used is beyond the scope of this presentation.

In a discussion on applied investigation with single-subject design, Kazdin (1982) poses two criteria to be used for assessing the effects of intervention. The *experimental criterion* refers to the ways in which data are evaluated to determine if the intervention has had an effect. The *therapeutic criterion* refers to whether or not the effects of the intervention are important or have clinical or applied significance (p. 230).

1. EXPERIMENTAL CRITERION. Investigators using single subject design have traditionally used visual analysis techniques to assess the effects of interventions. Data is displayed graphically over the course of the baseline and intervention conditions. Differences between the phases are inspected and analysed using four main criteria which are based on the statistical properties of the data (Kazdin, 1982):

MEAN refers to the average rate of performance in a phase.

LEVEL refers to the shift or discontinuity of performance from the end of one phase to the beginning of the next.

TREND refers to the tendency of data to increase or decrease over time.

LATENCY refers to the period between the onset and termination of one condition and changes in performance.

Visual analysis is regarded as a rigorous method of evaluation and can be useful in identifying reliable interventions (Siedentop, 1981). Changes in the dependent variables which are graphically observable are usually only produced by very strong interventions. Criticisms of visual analyses include concerns for the lack of objective criteria, the difficulty that is incurred with overlapping data, and the inability of the researcher to visually detect the effects of weaker interventions. Deprospero & Cohen (1979) conducted a study which revealed marked inconsistencies in the results of visual analysis of intra-subject data. Factors which were considered to have had an effect on the results were the format of presentations, intra and extra-experimental concerns.

For the majority of the single-case studies reviewed the investigators employed visual analysis techniques and based their conclusions almost exclusively on observable differences in the rates of behavior or performance. This approach is also a feature of the research completed at the Ohio State University. Darst (1976), for example, compared the rates of nine defined categories of teacher behavior and three defined categories of student behavior. The data were plotted and the mean baseline and mean intervention rate by category for all behaviors calculated. A subsequent behavior rate profile was formed and used to aid evaluation. As a result, the packaged intervention was determined to influence a measure of control over the behaviors of student teachers and pupils.

The use of statistics for the evaluation of change in single case research has been a controversal issue. The major concern seems to be that results which are statistically significant may not be of applied significance (Kazdin, 1982; Schutz & Goodman,1982). However, the use of statistical analyses may be necessary under certain conditions such as the failure to establish a stable baseline, the investigation of new researh areas, and instances of increased intra-subject variability (Kazdin, 1982). Conventional statistics are definitely not appropriate for use in singlesubject designs as they are biased due to serial dependency and focus on the mean while ignoring trends in the data (Kazdin, 1982; Murphey and Bryan, 1980). Time-series analysis is a statistical technique which silmultaneously examines trends within conditions, across conditions, and changes in the level of the data across phases. Time-series analysis is generally accepted as the most appropriate method available for single-case statistical analysis (Kazdin, 1982; Schutz & Goodman, 1982; Murphey and Bryan, 1980).

With the exception of one of the studies reviewed, visual inspection of the data was used to determine the experimental criterion. McBride (1984) incorporated both visual and statistical analyses in a study of systematic teacher training. Repeated measures analysis of variance were conducted to assess the significance of emerging trends between the groups and within individuals. Unfortunately, McBride failed to discuss the rationale behind his choice of analysis techniques.

2. THERAPEUTIC CRITERION. In determining whether or not the effects of an intervention are of applied or clinical significance, a number of questions need to be addressed.

1. Does the change in the level of performance have practical or social implications? Statistical or visual analyses indicate whether or not a change in performance has occurred but not the significance of this change in the level of performance to the practitioner. According to several investigators (Dodds, 1979; Darst, 1976; McKenzie,

1981) the ultimate criterion for social usefulness rest on whether or not the student teacher considered their changes in behavior to be helpful in conducting successful learning expriences for their students.

> The opinion of the student teacher relative to the significance of the behavior change may be more important than any other person or statistical treatment. (Darst, 1976, p. 340)

2. Is the procedure efficient in terms of time and cost? How much time and money is required to implement the intervention and is this amount excessive?
3. Can the intervention be implemented under normal operating conditions? Thomas (1982) discusses this question in reference to the evaluation of field testing. He suggests that successful field testing should yield a user ready innovation capable of being dispersed to relevant users and adopted widely (p. 195).

In general there appears to have been a general lack of concern for the therapeutic criteria. Researchers have typically reported the results of visual or statistical analyses with little or no discussion on how these results were appraised. Very few investigators have considered the justification of their training programs in terms of time or cost. Perhaps even more significant is the disregard for the monitoring of intervention procedures. In most cases, conclusions were drawn concerning the effectiveness of the intervention without the experimenters having gauged how much of the intervention was implemented, or under what constraints. For the overall evaluation of intervention programs in the physical education environment, the results of data analyses must be integrated with answers to the above questions.

Chapter III

DEVELOPMENT OF A SKILL ANALYSIS PARADIGM

Based on the review of the literature a skill analysis paradigm was developed which represents a conceptualization of the entire analysis process. The model has been derived by synthesizing what the author considers to be the strengths of each of the various presented approaches to skill analysis. The procedure used to construct the paradigm is outlined below.

1. Skill analysis, viewed as a holistic, process was determined to consist of four major phases: (a) pre-observation, (b) observation, (c) diagnosis, and (d) remediation.

2. There was strong support in the literature for a pre-observation phase which focused on the identification of critical features. The pre-observation phase was divided into four stages. The first stage is a conceptual movement analysis which consists of the identification of the goal or purpose of the skill, simplification of the movement, identification of the mechanical constructs, and finally the identification of the critical features. A second part of the pre-observation phase was identified and determined to involve the formation of an observational plan and recording form. This involves first, the selection of the critical features which will form the focus of the observation, consideration of the scanning strategies which will facilitate the observational process, and consideration of the optimal positions to assume throughout the observation process. A number of instruments for recording observations were presented in the literature.

   Following the development of the observation plan and recording form the paradigm focuses on the consideration of the direct and indirect constraints on the observation process. The purpose of this consideration is to promote an awareness of the factors which affect the perceptual process as well as of other correlates which may interfere with the performance of the skill. The final stage in the pre-observation phase was identified to be the determination of an acceptable response range.

3. In the observation phase the observer receives visual sensory input which must be appropriately monitored and filtered. Although the results of investigations which attempted to examine the use of imagery were inconclusive, the general consensus was that experienced observers do adopt some form of imagery strategies. The visual information may then be sent to the memory storage systems and should also be manually recorded.

4. Based on the Clinical Diagnosis Model presented by Hoffman (1982), the diagnosis phase of this paradigm is initiated by the recognition of a discrepancy between the learner response and the desired response. This involves identification of the errors in a performance followed by discrimination between the primary and secondary errors.

5. Following the determination of the causes of the primary errors, remediation takes place. All authors were in agreement that the final stage in the skill analysis process is the provision of feedback based on a remedy.

The model which resulted from the synthesis of literature is presented in Figure 8. Each of the boxes in the paradigm represents a skill or activity. The model suggests that competency in each of these skills or activities will result in the formation of accurate and effective remediation. In summary, the model serves to focus attention on those factors which the results of the literature review have deemed to be critical to the analyses of gross motor performances.

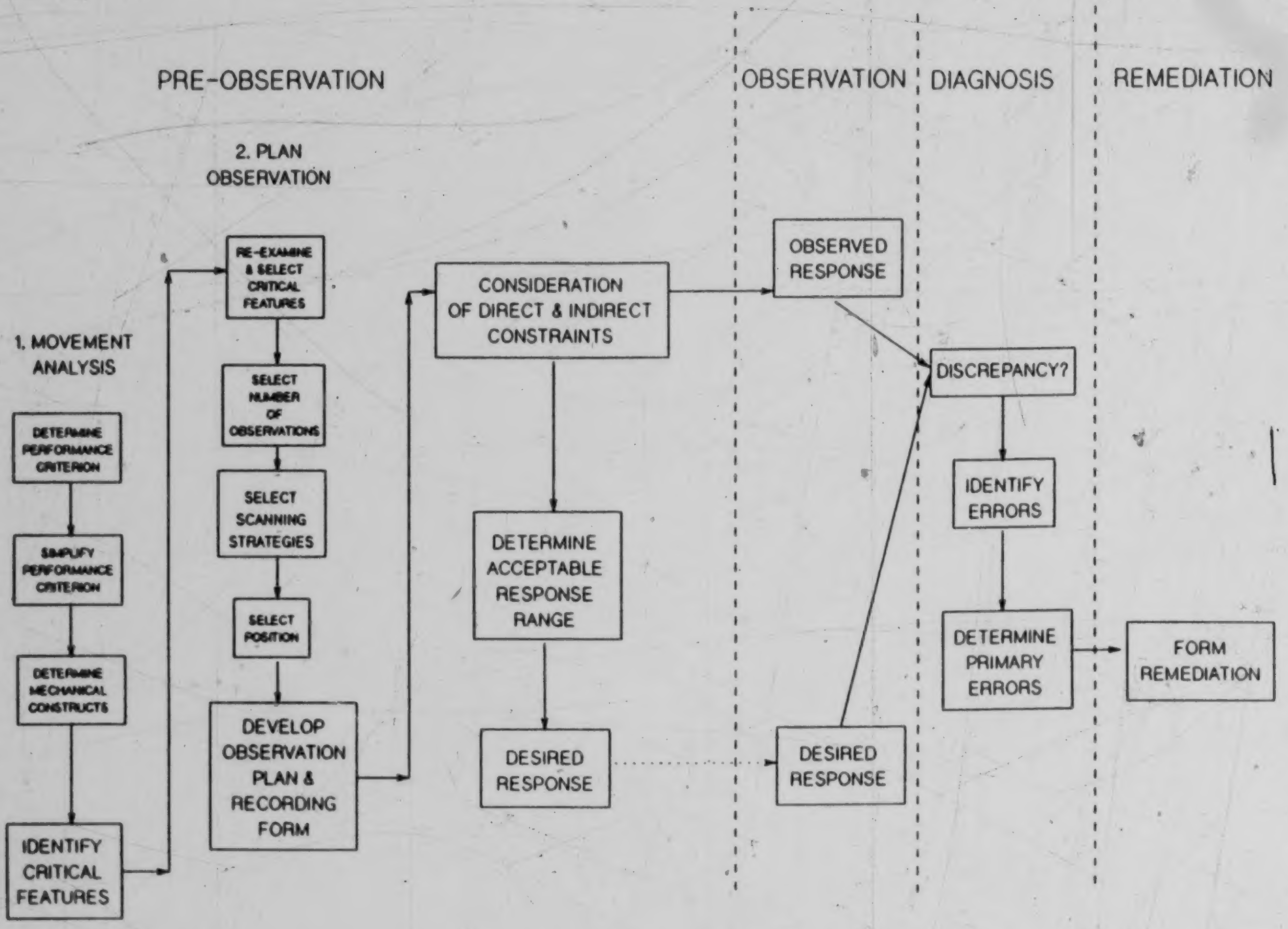

PRE-OBSERVATION
OBSERVATION
DIAGNOSIS
REMEDIATION
1. MOVEMENT ANALYSIS
DETERMINE PERFORMANCE CRITERION
SIMPLIFY PERFORMANCE CRITERION
DETERMINE MECHANICAL CONSTRUCTS
IDENTIFY CRITICAL FEATURES
2. PLAN OBSERVATION
RE-EXAMINE & SELECT CRITICAL FEATURES
SELECT NUMBER OF OBSERVATIONS
SELECT SCANNING STRATEGIES
SELECT POSITION
DEVELOP OBSERVATION PLAN & RECORDING FORM
CONSIDERATION OF DIRECT & INDIRECT CONSTRAINTS
DETERMINE ACCEPTABLE RESPONSE RANGE
DESIRED RESPONSE
OBSERVED RESPONSE
DESIRED RESPONSE
DISCREPANCY?
IDENTIFY ERRORS
DETERMINE PRIMARY ERRORS
FORM REMEDIATION

Figure 8. A paradigm for Skill Analysis

Chapter IV

DEVELOPMENT OF THE PRELIMINARY FIELD TEST

DEVELOPMENT OF THE INSTRUCTIONAL UNITS AND MATERIALS

The first stage in the development of the skill analysis training program was the construction of the program components, the instructional units. Each of the instructional units was designed to effect a positive change in one or more of the target skills previously identified in the skill analysis paradigm, and their development was based on the review of the relevant literature. Associated with each of the instructional units were the following components:

1. An objective or series of objectives: The components of each instructional unit were developed to address specific objectives. The objectives were expressed as the learner behavior which would be accepted as evidence of the attainment of the skills required to reach the target goal.
2. An introductory mini-lecture: Mini-lectures were prepared to present the introductory comments, statement of the objective and rationale, direct the participants on how to use the information in a structured experience, and to provide a number of examples.
3. Learning and Practice Activities: Each unit included one or more learning and practice activities. Tasks were developed for both individual and structured small group experiences. Where possible, alternatives were provided to accomodate individual differences in sport and movement experiences.
4. Visual Materials: Visual materials were developed as a key component of the instructional units. The use of visual materials provided an opportunity to illustrate the examples as well as provide for the practice of the analytic strategies in a controlled environment. The following visual materials were developed:
    a. 16mm film records of play school children, ranging in age from six to 10 years old, performing four fundamental skills: the vertical jump, standing long jump, overarm throw, and the cartwheel. The children were filmed at a rate of 50 frames per

second(FPS) from both a front and side view. Based on the technique outlined by Hay & Reid (1982), theoretical models were developed for each of the four skills. The information needed to conceptually analyze these skills was derived from a review of the available literature and from information gleaned through discussions with experts in the field.

b. Video taped performances of the play school children performing the four skills previously identified. The tapes were recorded to illustrate the effects of viewing movement from different positions, as well as to illustrate the effect of scanning the entire body or movement versus focusing in on specific body parts or components of the movement.

c. Overhead transparencies were developed to illustrate, outline, and provide examples which enhanced the presentation of the other instructional unit components.

d. Handouts of diagrams and drawings were prepared. Also included in the package of handouts was the skill anlaysis paradigm and the simplified versions of the paradigm, as well as the theoretical models developed for the four fundamental skills.

e. The instructional videotape entitled "Biomechanics: Qualitative Analysis" (Bedingfield, E.W. & McPherson, M.N., 1985) was also added to the list of visual materials.

5. Resources: A resource package was compiled to supplement the information provided in the instructional units. Resources included handouts, reference lists, and readings placed on reserve.

6. Feedback: A period of time in each instructional unit was allocated for the gathering and provision of feedback. Techniques for administering feedback included verbal mediation and reinforcement.

DEVELOPMENT OF THE TRAINING PACKAGE

Once the components of the instructional units were developed they were arranged into four modules. Each of the modules was devoted to one phase of the skill analysis paradigm and included a group of skill analysis target goals. Module one included instructional units devoted to the Movement Analysis, Planning for Observation, Development of an Acceptable Response Range, and the Consideration of Direct and Indirect Constraints stages. The second module focused on the Observation phase of the skill analysis paradigm. The third module addressed the Diagnostic phase and included an instructional unit which focused on the Identification of Primary Errors. The fourth and final module included an instructional unit which was devoted to the both the Remediation phase and an overview of the entire skill analysis process.

The development of a modular approach to the presentation of the skill analysis paradigm was followed by the estimation of time required to complete each of the instructional units and the modules. The total training program was estimated to require a minimum of 27 hours. A breakdown of the modules, their respective instructional units, and the estimated time factors is presented in Figure 9.

MODULE	INSTRUCTIONAL UNIT	TIME (HOURS)
PRE-OBSERVATION	- Movement Analysis - Observation Plan - Determine Acceptable Response Range - Indirect & Direct Constraints	16
OBSERVATION	-Adoption of Observation Stategies	5
DIAGNOSIS	- Identification of Primary Errors	4
REMEDIATION	- Formation of a Remedy - Summary	2

Figure 9. Skill Analysis Modules, Instructional Units, and the Estimated Time Components

DEVELOPMENT OF THE PRELIMINARY FIELD TEST

A preliminary field test of the packaged training program was developed to be conducted during the Spring of 1986. The investigation was undertaken to determine:

1. A record of the reactions, opinions, and concerns related to the effectiveness of the components of each of the instructional units.
2. The impact of the training program on a sample of physical education students, teachers, and coaches.
3. The impact of the skill analysis paradigm on a sample of physical education students, teachers, and coaches.
4. The feasibility of the implementation format and the imposed time constraints.
5. The suitability of using the changing criterion multiple probe design to examine the effect of several instructional units on the ability to identify the target goals.

Conclusions drawn from the analysis of the preliminary field test results were used to make decisions regarding the development, implementation, and evaluation of the final field test.

DETERMINATION OF THE TRAINING PROGRAM FORMAT

Following the development of the training package a meeting with members of the project committee was held to determine the format best suited for the presentation of the skill analysis training program. The following program criteria were discussed:

1. A minimum of 27 hours was required to cover the four modules.
2. In order to maintain the integrity of the training program a format which allowed for concentrated and consistent exposure to the skill analysis paradigm was desired.
3. The subjects chosen to participate in the Preliminary Field Test required a strong Physical Education background which included exposure to the area of Biomechanics, teaching or coaching experience, and an interest in the skill analysis process.
4. An incentive was needed to attract subjects and ensure their completion of the training program.

As a result of the meeting, permission was obtained from the Department of Secondary Education to offer a course entitled *Strategies for the Observation and Analysis of Motor Skills* during the University Intersession term. The implementation of the preliminary training program as a seminar course ensured the required number of hours, flexibility in program scheduling, and the opportunity to attract subjects with the prerequisite experiences. In addition, the potential for attaining a University credit for completion of the course provided the necessary incentive to attract the desired participants.

SAMPLE

The Preliminary Field Test was based on the information obtained from eight subjects between the ages of 21 and 45 years of age enrolled in *Strategies for the Observation and Analysis of Motor Skills* (see Appendix 1: Course outline #1 & Appendix 2: PFT Course Schedule). All subjects met the investigators requirements regarding background and experience in Physical Education, teaching and coaching experience, and an interest in the skill analysis process. In order to gather additional information concerning previous observation and analysis experiences, as well as the details of the subjects' background in biomechanics and skill analysis, a questionnaire (see Appendix 3: Subject Questionnaire) was completed. The questionnaire was also used to gather information which would help the investigator shape the discussions and movement examples to the interests of the group. A summary of the experiences and background of each of the subjects is presented in Table 1.

Table 1. Preliminary Field Test Subject Information

	SUBJECT ONE	SUBJECT TWO
Post-secondary Education	- B.ED (Elementary PE) - M.ED (ELementary PE) - PH.D Candidate	- B.ED (Elementary PE) - M.ED (Elementary PE) - PH.D Provisional Candidate
Related Course Work	- Intro. Biomechanics,	- Intro. Biomechanics,
NCCP Certification	- N/A	- N/A
PE Teaching Experience	- Elementary PE (4 years) - Elementary PE Consultant - University Movement ED (8 years)	- Elementary PE (5 years) - Junior High PE (5 years) - University Movement ED (8 years)
Coaching & Instructing Experience	- Creative & Folk Dance - Recreational Racquetball	- Community, Junior & Senior High Basketball - Special Population Swimming -Junior High Track & Field, Badminton, Volleyball - Creative & Folk Dance
Officiating Experience	- N/A	-Intramural Sports Referree
Activities With Which Most Familiar	1. Educational Gymnastics 2. Racquetball 3. Alpine Skiing 4. Educational Games 5. Creative Dance	1. Basketball 2. Volleyball 3. Tennis 4. Skating

Table 1. Continued

	SUBJECT THREE	SUBJECT FOUR
Post-secondary Education	- B.PE - M.A (Completed 2 years)	- ED Diploma (Dance) - Teacher Certification - M.A. (PE, Dance)
Related Course Work	- Intro. Biomechanics, - Movement Education	- Biomechanics & Qualitative Analysis - Skill Analysis in Dance -Movement Analysis Notation
NCCP Certification	-Level 1 Theory	- N/A
PE Teaching Experience	- University Movement Education (2 years)	- Junior & Senior High PE (4 years)
Coaching & Instructing Experience	- High School & University Volleyball - Recreational Baseball - Recreational Swimming - Recreational Gymnastics - University Creative, Folk, and Jazz Dance	- Recreational, Community, College, & Professional Ballet, Modern, Creative, & Indian Dance
Officiating Experience	- Volleyball Referree	- Dance Judge & Examiner -Intramural Sports Referree
Activities With Which Most Familiar	1. Volleyball 2. Basketball 3. Soccer 4. Dance 5. Running	1. Dance 2. Floor Hockey 3. Swimming 4. Tennis 5. Badminton

Table 1. Continued

	SUBJECT FIVE	SUBJECT SIX
Post-secondary Education	- B.ED (PE) - M.ED (Completed 1 year)	-B.ED (PE) - M.ED (Completed 1 year)
Related Course Work	- Intro. PE Course Work	- Intro. Biomechanics & Kinesiology
NCCP Certification	- N/A	- Level 1 Technical: Badminton, Track & Field, Football
PE Teaching Experience	- Elementary PE (6 years)	- Junior & Senior High PE (3 years)
Coaching & Instructing Experience	- Community Softball -Senior High Badminton - College & City Hockey - High School Volleyball, Basketball - Junior & Senior High Track & Field	- Junior & Senior High & Club Volleyball - Junior High Track & Field, Badminton - Community Hockey
Officiating Experience	- Volleyball & Basketball Referree	- High School Volleyball, Basketball, & Hockey Referree
Activities With Which Most Familiar	1. Volleyball 2. Basketball 3. Racquetball 4. Golf/Curling 5. Football	1. Volleyball 2. Hockey 3. Swimming 4. Track & Field 5. Football

Table 1. Continued

	SUBJECT SEVEN	SUBJECT EIGHT
Post-secondary Education	- B.ED (Elementary PE) - M.ED (Completed 1 year)	- B.ED (PE)
Related Course Work	- Intro. PE Course Work	- Intro. PE Course Work
NCCP Certification	- Level 1 Technical: Basketball	- Level 2 Theory
PE Teaching Experience	- Elementary PE (1 year) - Secondary PE (7 years) - College PE (8 years)	- Elementary & Junior High PE (2 years) -Senior High PE (8 years)
Coaching & Instructing Experience	- High School & College Basketball - High School Track & Field, Volleyball, Cross-Country	- Junior & Senior High Volleyball, Basketball -Junior High Track & Field, Badminton
Officiating Experience	- Volleyball & Basketball & Football Referree	- Volleyball Referree
Activities With Which Most Familiar	1. Basketball 2. Volleyball 3. Track & Field 4. Football 5. Hockey	1. Volleyball 2. Basketball 3. Baseball 4. Badminton 5. Archery

Based on the information that was included in the completed questionnaires, the investigator made a decision to start the course with an introductory six hour review of basic biomechanical principles and concepts. While all subjects had previous exposure to biomechanics, they expressed some concern as to the degree of competency that was expected. Many of the subjects had not taken a biomechanics course in over six years. The intent of the refresher session was to present an overview of the material which the investigator believed to be part of the fundamental knowledge base required for enrollment in a skill analysis training program. The content of the refresher sessions was primarily based on the material covered in the first 3 levels of the NCCP Theory: Skill Analysis chapters.

The biomechanics review was not considered part of the skill analysis training program and, consequently, its evaluation is not considered to be one of the objectives of this study. The investigator acknowledges, however, that the ability of the course participants to integrate the content of the skill analysis training program may be a reflection on their background in biomechanics and is worthy of future evaluation.

Chapter V

THE PRELIMINARY FIELD TEST

IMPLEMENTATION OF THE PRELIMINARY FIELD TEST

The eight course participants were involved in nine course sessions totalling 33 hours of class time. All sessions were instructed, coordinated and supervised by the investigator. Short lectures followed by the presentation and discussion of relevant examples were the techniques used to present the material in each of the instructional units. All participants were led through each of the modules in the training program in succession. Overhead transparencies of diagrams and drawings, 16mm films, and videotapes were used to further exemplify the participants understanding of the course content(see Appendix 4: PFT Program Outline). Throughout the program the investigator attempted to create an informal and relaxed atmosphere by encouraging discussions, assigning tasks for small groups, providing positive reinforcement, and allowing time for coffee break discussions.

DATA COLLECTION AND ANALYSIS PROCEDURES

A variety of data gathering tools were used to determine the underlying objectives of the Preliminary Field Test. In order to obtain information regarding the first four of the previously stated study objectives, four primary sources of information were identified. These included the completion and discussion of assigned group and individual tasks, completion and presentation of an assigned small group project, daily and summary journal entries, and recorded investigator observations.

The skill analysis training program included numerous learning and practice activities. The purpose of the tasks was twofold. First, the activities constituted a key component of the developed instructional units and, therefore, were a key part of the treatment package. The individual and small group experiences provided the participants with an opportunity to apply the concepts and skills introduced in each of the instructional units in a practical and structured manner. Secondly, the ability of the participants to complete the activities, as well as the quality of the observed and recorded responses, furnished important information concerning the effectiveness of the instructional units.

The second source of information resulted from the evaluation of an assigned small group project (see Appendix 5: Video project) which focused on the development of an observation plan. The evaluation provided information on the effectiveness of the instructional unit.

The third source of information was the course journals which each of the participants were required to complete. The journals included daily entries as well as a number of focused summary discussions. An outline which detailed the journal requirements was issued to each of the subjects during the first session and is presented in Figure 10.

1. ENTRY FOR EACH SESSION
INCLUDE:
- Session objectives
- How did the instructor attempt to meet these objectives?
Which activities,discussions...were particularly helpful?
-Which activities, discussions...were confusing? Why?
-Did the session raise any reactions, revelations, queries...?
- Recommendations on how to improve the session?

2. END OF COURSE SUMMARY
1. Has your understanding of the analysis process changed? How?
2. Will your approach to the analysis process change as a result of this course? If so, how?
3. Do you feel that you could apply the paradigm for skill analysis to the analysis of other skills or movements not covered in the course sessions?
4. Were the time constraints imposed satisfactory?

3. WHAT IS YOUR:
- Overall impression of the skill analysis paradigm?
- Overall impression of the visual materials?
- Overall impression of the readings?
- Overall impression of the activities and tasks?
- Recommendations???

Figure 10. Course Journal

The journal furnished critical information related to the components of the instructional unit, feasibility of the program format and time constraints, as well as the participants' reaction to the skill analysis paradigm and training program.

The final source of information associated with the Preliminary Field Test was the recorded observations made by the investigator. Throughout the implementation of the Preliminary Field Test a journal, in which daily entries recorded the discussions and perceived reactions to the material covered, was maintained. These observations were used to enhance analysis of the information derived from the three sources previously identified.

A final objective of the Preliminary Field Test was to assess the suitability of using a changing criterion/multiple probe design to examine the effect of an instructional unit intervention on evoking a stepwise change in an identified target goal. A series of three tests was implemented during the movement analysis instructional unit in order to determine if changes in the target goal occurred in a stepwise manner. An additional assessment was made by applying the design described by Horner & Baer (1978) to the second stage of the pre-observation module. The design attempted to examine the efficacy of the relationship between the implementation of an instructional unit and the ability to develop an observation plan. The independent variables consisted of the components of the instructional unit which dealt with the development of scanning strategies, position strategies, and the consideration of developing an observation plan into a practical format. The dependent variable was the development of an observation plan. Probe measurements were made by testing the development of an observation plan for a number of defined critical features. Each plan developed by the trainee represented a test or a "probe" of the dependent variable.

Information concerning the extent to which the skill analysis training program was implemented, as well as to the existence any unintended effects, were gathered as part of the supplemental information. Monitoring the implementation of the intervention permitted the examination of a relationship between the objectives, learning experiences, and appraised procedures. Daily journal entries, recording personal thoughts and feelings, provided a comparative check of the theoretical study and the planned curriculum (Agnew & Sweeney, 1984). Informal observations made by the investigator served to supplement this information. Information related to the existence of any unintended effects of the program was derived through the analysis of journals, group discussions, and informal investigator observations. A summary of the procedures used to gather this information is presented in Figure 11.

SUPPLEMENTARY INFORMATION	EVALUATION PROCEDURE
Execution of the Treatment	- Informal observations - Comparison of journals with planned outline
Supplemental Learning	- Subject journals - Informal observations -Investigator journal
Unintended Learning Effects	- Subject journals - Informal observation -Investigator journal

Figure 11. Evaluation procedures used to gather supplementary information

DATA ANALYSIS

Prior to the selection of the analysis techniques to be adopted for use in the Preliminary Field Test, a thorough review of the relevant literature was undertaken. The lack of theory and innovative research on the determination and evaluation of training program designed to promote skill analysis competency was discussed in detail in Chapter II. Consequently, a level of analysis which was primarily descriptive was chosen. This decision was based on the desire of the investigator to meet the objectives of the preliminary study by examining subjectively the nature of the effects of the structure and content of the training program on the participants' understanding, attitudes, and reactions to the skill analysis paradigm and training program. The results of the analyses were used to revise the training program as well as to conduct an experimental evaluation of the effect of the training program on skill analysis competency in the final study.

The participants' responses to each of the assigned tasks were discussed and recorded. Any inabilities to complete a task, or component of the task, were recorded for further examination. A subjective evaluation of the group projects was made by the investigator and was based on the following criteria:

1. Development of an observation plan which addressed all the components which had been previously identified as critical to the observation process.
2. Justification for all choices made for the subsequent video observation.
3. Development of a practical observation plan and recording form.
4. Application of the developed observation plan to a videotaped recording of the assigned skill.

The participants' reactions to the units, the skill analysis paradigm, and the training program were obtained from the journals and were analyzed in several ways. An initial review highlighted the diversity and wealth of information which was provided. In particular, it was evident that there was a great deal of overlap in the data obtained from the responses to specific summary questions and the daily journal entries. In order to optimize the utilization of this information, material which related to each of the instructional topics, units, visual materials, learning and practice activities, and resource packages was summarised and grouped. The reactions of the participants to the skill analysis paradigm and the training program were examined for individual differences and for the existence of any patterns in the subjects' reactions. Observations recorded by the investigator were used to enhance the analysis and discussion of results, as well as to shed light on any confusing or unexpected findings.

While there are a number of ways this qualitative information could have been analyzed, the summary and grouping of responses into the identified categories appeared to provide the greatest opportunity for the formation of summative conclusions to be considered in the final revision of the training program.

Chapter VI

ANALYSIS AND DISCUSSION OF THE PRELIMINARY FIELD TEST RESULTS

Information was gathered to examine the impact of the components of the instructional units, the skill analysis paradigm, and the training program, as well as the implementation format and imposed time constraints on eight subjects enrolled in *Strategies For Teacher and Coach Observation and Analysis of Motor Skills*. In addition, the suitabilty of the changing criterion design as a means of assessing competency in an identified target goal was investigated. Finally, information regarding the implementation of the treatment and the existence of any unintended effects was also collected and analyzed.

COMPONENTS OF THE INSTRUCTIONAL UNITS

The instructional units were composed of six basic components: an introductory mini-lecture, practice and learning activities, visual materials, resources, and feedback. All of the recorded statements that focused on a concern, question, difficulty or suggestion for any of the instructional unit components were summarized and grouped according to the unit (see Appendix 6: Summary of PFT Results). When more then one subject expressed the same view, a single statement was developed that best characterized the view without changing the substantive content. The results on the effectiveness of the components of the instructional units are presented and discussed under the specific unit headings.

MOVEMENT ANALYSIS

Four of the subjects expressed a desire to receive more information initially on the significance of the identification of the critical features, and of the movement analysis stage in general. This was considered by the investigator to be a valid concern. Aside from a brief definition of movement analysis and its theoretical rationale, very little information was initially provided. Throughout the implementation of the first instructional unit a series of tests were assigned to determine if the attainment of the target goal, the identification of critical features, occured in a stepwise manner. The inclusion of the tests precluded the provision of any information related to the description of the target goal. The investigator observed that the lack of information regarding the purpose and direction of the movement analysis stage particularly attenuated the subjects' understanding of the determination of the performance criterion and simplication of the movement into parts. This observation was verified by the recorded journal entries of six of the participants. Several comments focused on the lack of familiarity with a particular skill which resulted in an inability to determine the performance criterion. Differences in the use and definition of some of the terms also caused a problem for three subjects. In most cases the terms were related to mechanics and, in the past, had been used by the participants incorrectly. The investigator's inconsistent use of the terms ~~step,~~ stage, and phase was the source of the remaining difficulties. These terms were re-defined in the following session.

A discussion developed during instruction on the third step of the movement analysis stage, the determination of the mechanical factors. One of the subjects questioned the value of reducing the skill to a level which included only a series of mechanical determinants.

> The difficulty for me occurred because of the statement that all movement is governed by mechanical laws and these are therefore the key features of the movement analysis model. The fact that all movement takes place in space and time seems irrelevant. (Subject Four)

The subject in question had been extensively involved in the use of Laban analysis as a basis for the notation, analysis, and instruction of dance. The definition of technique that this particular student had developed was very different from the definition on which the skill analysis paradigm was based. As a result of the discussion, time was spent reviewing the assumptions of the skill analysis paradigm which related both to the definition of technique and open and closed skills. Once again the investigator noted that the lack of a clearly defined target goal retarded the group's grasp of the significance of reducing a skill to the level of mechanical determinants.

The movement analysis unit consisted of five assigned activities. Difficulties that were expressed both in the participants and the investigator journals related to the activities which focused on the first two steps in the movements analysis stage. The concerns paralleled those that were discussed regarding the instructional unit. All particpants expressed positive reactions to the demonstration activity, cartwheel activity, and the identification of critical features from filmed performances. The activities were all completed to the investigator's satisfaction.

The only concerns that were expressed regarding the visual materials related to the use of an overhead transparency for the movement analysis model example. One subject suggested that the appropriate movement analysis step should be indicated beside the corresponding level on the model. This suggestion related back to the confusion between the terms step, stage, and phase.

PLANNING FOR OBSERVATION

The second instructional unit focused on the need to plan for observation. One subject expressed concern over the lack of initial information regarding the purpose and direction of this stage of the skill analysis process. Once again an attempt to assess the suitability of a single subject design precluded the initial provision of detailed information on the developed observation plan and recording form. However, aside from one comment this did not appear to have as strong an impact on the assimilation of the information as in the presentation of the movement analysis stage.

All participants verbally expressed confusion over the identification of predictive features. This was evident in the recorded entries of seven of the participants. The problems seemed to centre on the distinction between a critical feature and a predictive feature. Based on the observations of the investigator, the difficulties that were encountered were a result of the provision of very few examples and imposed time constraints on discussion time. Three of the subjects recorded comments which related to the lack of a guideline for the selection of an optimal number of observations. Aside from these concerns the instructional unit was very well received. The investigator observed much enthusiasm and an appreciation for the significance of the material and its practical application.

Three activities were included in the planning for observation instructional unit. All participants verbally expressed satisfaction with the learning and practice activities included in this unit and were able to successfully complete them. The visual materials used to illustrate the content and provide examples included the 16mm film, the videotape, and overhead transparencies and all were well received.

The instructional unit culminated in the completion of a small group video project. The experience proved to be a worthwhile one both as a component of the instructional unit and as an evaluative tool. All of the participants commented on the personal benefits that were gained from this activity. Two of the subjects discussed how much the project reinforced the complexity of the analysis process.

> Today it was reinforced to me the importance of and the difficulties associated with the observation of movement. Without the focus its very hard if not almost impossible to detect movement problems. (Subject Six)

> The presentation and viewing of others presentations provided me with more concrete evidence of the complexity of the total process. (Subject One)

Several subjects stated the value of applying the information derived from the planning for observation instructional unit to a practical experience.

> It allowed me to learn about the whole process of observation through personal experience. (Subject Two)

> Without this activity, I believe it would all still seem like a lot of theory.
> (Subject Five)

One subject stated that the project made her realize the allowances that the skill analysis paradigm made for individual differences. This was clearly expressed by Subject Seven.

> I also became aware that what a coach at a high level might want to focus in upon in regards to critical features may not be what a teacher in the classroom wants. These differentiations will be reflected in the Observation tool you eventually assemble.
> (Subject Seven)

The project provided the investigator with the opportunity to conduct an evaluation of the effectiveness of the entire instructional unit. An evaluation of the required written and verbal presentation of the projects yielded the following results.

1. All participants were able to develop an observation plan.
2. Each plan addressed all the components of an observation plan which had been previously identified as critical.

3. All participants were able to justify the choices they had made with regards to the observation strategies.
4. The suitability of the plan was verified by the participant's ability to apply the plan using video equipment to simulate the human eye.

CONSIDERATION OF DIRECT AND INDIRECT CONSTRAINTS

Following the completion of the video project, a short instructional unit was presented on the indirect and direct constraints on performance. The investigator observed that all of the participants were familiar with the content of this unit.

> Most of the information offered here reinforced many of the concepts we are already somewhat familiar with. However it was nice to put them into a logical and practical order. (Subject Five)

Participants provided many examples of their teacher, coach, and participant experiences. None of the subjects expressed any confusion related to the content of this instructional unit. Prior to the implementation of the unit the investigator had questioned precisely where in the skill analysis paradigm the unit could be best included. The results of the recorded journal entries and the investigators' observations suggested that the unit was effectively addressed following the development of the observation plan. However, this is believed to be due to the extensive teaching and coaching experiences of the sample. All of the subjects stated that they had been considering the indirect and direct constraints on performance throughout the course. This was verified by the completed video projects in which many of the groups had attempted to maximize the color contrasts and minimize the external distractions. With a less experienced group of participants it might be more beneficial to present this unit prior to the presentation of the planning for observation stage.

Although there were no activities associated with the instructional unit the instructor guided discussions around the ideas and the available visual resources.

DETERMINATION OF AN ACCEPTABLE RESPONSE RANGE

A unit which focused on the determination of an acceptable response range was initiated by the assignment of a homework activity. In the session which followed the activity was discussed and the rest of the unit was implemented.

The investigator observed that the instructional unit which focused on the determination of an acceptable response range was both effective and informative. The purpose of the exercise was, first, to draw the participants attention to the need to consider an acceptable response range for any given observation experience. Secondly, the unit attempted to increase awareness of the complexity of forming a mental image.

> I had difficulty trying to draw the different body segments so I found a book which showed a sequential diagram of the skill. (Subject Two)
>
> I thought I knew what the movement looked like but when I came to draw it I found that I didn't really know at all. (Subject Five)
>
> I wasn't able to envisage the actions of the specific body segments. (Subject Four)

The subjects' reactions clearly indicated that the activity had had an impact on their appreciation of the complexity of forming mental images. One of the subjects suggested that the pictorial representation of the critical features in a movement could be better accomplished using symbols as opposed to stick figure drawings. While this may well be the case it would require the development of a system of critical feature symbols and the subsequent instruction in the system. None of the participants questioned the need to address the formation of an acceptable response range.

DIAGNOSIS

The Diagnosis phase of the paradigm included one instructional unit which focused on the determination of the primary errors in a performance. The majority of the recorded comments discussed the presentation of the hypothetico-deductive model for problem solving (Hoffman, 1982) which was presented as an introduction to the diagnosis phase. In general, the comments stimulated thought about the model and its potential applications but they were not considered to be important in the context of a skill analysis training program which focused on technique. One subject expressed a desire to spend more time practicing the identification of errors. The investigator noted that while the material was very well received and appeared to be understood, the 1 1/2 hours devoted to the unit was not sufficient time to allow for extended practice.

REMEDIATION

The final instructional unit dealt first with the formation of a remedy based on the identified primary errors. A discussion on the significance of the Remediation phase was followed by an assigned group activity which required the participants to develop a remedy for the errors exhibited in the video-taped performances.

The second part of the instructional unit focused on an overview of the entire skill analysis paradigm and the training program. The objectives of each skill analysis phase, as well as the methods which were used to achieve the target goals, were outlined and re-defined. In addition, the investigator stressed the importance of a systematic approach to the analysis of motor skill. Guidelines for the integration of the approach into the participants' future teaching and coaching experiences were suggested. The unit was concluded with the presentation of a list of key statements written by skill analysis theorists.

An analysis of the subjects' journal entries did not reveal the existence of any concerns, problems or suggestions for the improvement of this instructional unit. All of the participants felt that the objectives, the content, and the activities of the Remediation unit were above satisfactory.

> I thought the summary of your favorite quotes was a meaningful way to end the course. I will keep them readily available as a source of enlightment when I am teaching next fall. (Subject Two)
>
> This was an interesting way to end the course and tie things together. We looked at the model in total and found it made a lot more sense now. (Subject One)
>
> This was a good opportunity to discuss some remediation ideas that we had been formulating over the last couple of days. (Subject One)

IMPACT OF THE SKILL ANALYSIS TRAINING PARADIGM

Subjects were requested to record their responses to a number of questions following the completion of the training program. Examination of the participants' response to their overall impression of the skill analysis paradigm and their thoughts regarding the potential for the application of the paradigm were used to form conclusions regarding the impact of the skill analysis paradigm.

> As for the application of the skill analysis paradigm to other skills, throughout this course I have been applying this process to two of the girls I coached on a Sr. girls volleyball team this past year. They both had problems with their spike. I was constantly breaking it down into places (the skill) and trying to detect where the errors were occuring. I had a mental picture of both of them perfoming the skill and a mental picture of what I considered the ideal. I am already in the process of breaking the skill down to go through the stages of the skill analysis paradigm. I'm excited, because now I feel that I can identify the discrepency beteween the two mental pictures and that I can be more effective as a coach in improving their techniques. When observing them before I lacked a focus, I viewed the skill in its entirety, so most of my feedback was addressing secondary errors, now I can focus and therefore identify primary errors. (Subject Six)

All of the subjects stated that the skill analysis paradigm was a good and practical approach. Generally, the participants felt that the paradigm would be useful both as a preservice and inservice experience for teachers and coaches. Furthermore, they felt that the approach could be easily transferred to the analysis of both open and closed skills that were not covered in the training program. The subjects recognized that if the teacher or coach was unfamiliar with a skill they would simply complete additional preliminary work in the conceptual analysis of the skill.

IMPACT OF THE TRAINING PROGRAM

> I believe my understanding of the analysis process has changed over the span of this course. Although I have used a type of analysis before I never seemed to be able to crystalize the center of focus (ie. the activity) in such a way as to be able to come to a decision as to the most important components of such and what to look for if errors were occuring. Most of this problem came from not having a plan of attack which was simplified enough to apply practically. This problem left me somewhat frustrated and disallusioned with skill analysis in general and often resulted in an analysis that was often superficial and incomplete when attempted. The steps we have gone through in this course has renewed my understanding of some of the basics and has encouraged me to think there is a practical way of doing it. (Subject Seven)

Further examination of the journals indicated a positive response to the training program. That the program had an impact on the participants was verified by the recorded changes to the subjects' understanding of, and approach to, the skill analysis process. Typical changes included an increased awareness of the complexity of the process and an awareness of the key components of the skill analysis process. Based on the number of references, the pre-observation phase appeared to have the greatest impact on the participants. Analysis of the journal summary entries highlighted an appreciation for the importance of a biomechanical base, the identification of the critical features, and the need to plan for the observation of movement.

Three of the subjects suggested that they were previously aware of the components of the skill analysis process but had never considered the process as a totality. Furthermore, their understanding of each phase had been considerably augmented.

The participants all felt that their approach to the skill analysis process would change as a result of the training program. In most cases these changes would center around the formation of a detailed plan of attack. An interesting conflict in views was expressed by two of the participants regarding the application of the training program to teacher training. Subject Three indicated that while her personal approach to the skill analysis process would change, the way in which she taught preservice teachers to analyze would not.

> It all boils down to the time restriction/material quantity ratio. It's just enough getting across minimal observation strategies that are basic, and seeing to it the students have a competent understanding of those strategies. (Subject Three)

Quite by contrast, Subject One expressed her enthusiasm and desire to incorporate the approach in her teacher training endeavours.

> But more important, I will try to teach the students the process in some way. Skill analysis might start to develop in some students early, in small steps, and gradually be practiced so that they can perfect the technique over a few years. If I start with my students in early courses in their degree program maybe by the end of their program they will have developed some expertise at it. (Subject One)

While the results of this study do not shed any light on the validity of either of the expressed views, the practical teacher training experience of the two subjects could be considered. Subject One had been teaching for 14 years while Subject Three had only two years of teaching experience. It may well be that as Subject Three refines her teaching techniques the adoption of the skill analysis approach may appear more feasible.

FEASIBILITY OF THE FORMAT AND THE IMPOSED TIME CONSTRAINTS

Journal entries were carefully analyzed to determine the feasibility of the training program format and the imposed time constraints. The results indicated that the subjects responded favourably to the course format. The integration of theory and practice was deemed to be a major contributing factor to the success of the Preliminary Field Test format.

Two of the subjects suggested that due to the time requirements of the training program the adoption of a course format for future programs would be superior to that of a workshop format. One subject expressed concern over the amount of retention that could be expected to occur following a course that spanned only 2 1/2 weeks. "Each phase/step needs a lot of exposure and time to absorb and apply it" (Subject Two). The investigator recognized the potential limitations of such a highly concentrated approach. The need, however, to address the schedule demands of each of the eight participants dictated the choice of a timeline and made this limitation unavoidable.

Throughout the course the participants expressed minor concerns over the time that was allotted to various activities. In particular, the group stated that more time was required to practice the identification of critical features and the identification of primary errors, as well as more time to practice the application of the skill analysis paradigm to the analysis of different skills. Only one of the subjects made any comments concerning the length of the individual sessions. This subject stated that he found the six hour sessions of more benefit then the three hour sessions.

EXAMINATION OF THE SUITABILITY OF THE CHANGING CRITERION RESEARCH DESIGN

Two investigations were undertaken during the implementation of the Preliminary Field Test to examine the suitability of a single subject design. The purpose of using the changing criterion design was to demonstrate a relationship between the independent variables and progressive changes in a dependent variable. The application of the multiple probe technique to this design provided an alternative to continuous measurement during extended baselines. The review of the relevant literature had indicated that the changing criterion design was particularly useful when changes in the target behavior were expected to occur in stepwise increments and when other designs were considered inconvenient or unsuitable (Hartmann & Hall, 1976).

Studies in which the use of the design had been reported had typically attempted to change the target behavior by increasing or decreasing the frequency of a behavior in stepwise increments. Although no information was found on the application of the design to interventions where other types of changes in the target behavior were expected, other applications appeared possible. Hall and Fox (in Press) suggested that the changing criterion design would be particularly suited to demonstrating the effectiveness of shaping procedures (Hartmann & Hall, 1976, p. 531).

The main objective of the first investigation of the design was to determine if the independent variables effected a stepwise change in the identification of critical features. Experimentation with the use of probe measurements was identified as a secondary objective. Three tests were assigned at different stages of the instructional unit on movement analysis. On each successive test an additional probe measurement of the dependent variable was made.

The results indicated that there were no clear or consistent patterns of performance for the identification of the critical features. Changes in the dependent variable were not found to occur in stepwise increments. Three of the subjects actually lowered their score on the second measurement of the critical features for the vertical jump. Similiarly, three of the subjects lowered their score on the final probe measurement for the vertical jump. For the second skill three of the subjects achieved the same score on the second probe measurement as on the first measurement. Four of the subjects made improvements on each successive measurement of the second skill. With two exceptions, the performance on the only measurement of the third skill was better then the performance on any of the other skills. The confounding nature of these results was attributed tothe following:

1. The time that was required to complete each probe measurement for the identification of the critical features was far greater than was originally estimated by the investigator. Analysis of the responses indicated that on each test the subject devoted the majority of the allotted time to the completion of the probe measurement of the new skill and neglected the responses for the repeated probe measurements. The amount of time required to implement the testing procedures was considered to be a major limitation of this design.
2. Due to the time constraints, no attempt was made to consider or control the stability of the baseline data.
3. The subjects verbally expressed boredom at being required to repeat the tests for the skills that were previously tested. This most certainly affected the quality of their responses and, therefore, the validity of the instrument.
4. All of the subjects recorded comments in their journals regarding the frustration they experienced as a result of not receiving any feedback on their performance on each of the tests. It is the belief of the investigator that not only did this interfere with the implementation of the movement analysis instructional unit it also resulted in decreased motivation levels on each successive test.

The results of the investigation indicated that components of the changing criterion test protocol were unsuited to the training program experience. Furthermore, despite the methodological limitations, the design did not provide any evidence to suggest that the dependent variable would make positive changes in a stepwise manner. Although the identification of the critical features in a performance is acheived by addressing a series of steps it was clear, in retrospect, that the positive changes would not be reflected by the continous measurement of the target goal. A much better way of examining the stepwise progression of the movement analysis phase would have been to change the dependent variable each time to match the learner objectives associated with each step.

Based on the time demands, the need to interfere with the learning process, and the confounding effects of frustration and motivation levels, the changing criterion design was determined to be unsuited to the evaluation of the instructional unit interventions.

SUPPLEMENTAL INFORMATION

An analysis of the subjects daily journal entries, completed activities, and observations made by the investigator provided the information necessary to verify the implementation of the treatment. A comparison of the planned program outline and the actual program outline(see Appendix 4: PFT Program Outline, p.) confirmed that all components of the training program were implemented as intended. Aside from slight variations in the amount of time devoted to the various instructional units there were no major differences between the planned and actual program. A summary of the deviations which occurred in each of the modules is presented in Table 2.

Table 2. Deviations Between the Planned and the Actual PFT Training Program

MODULE	TIME DIFFERENCE	COMPONENT ADDITIONS/DELETIONS
Pre-observation	+ 3 hours	- Added a discussion on terminology. - Re-defined assumptions of the skill analysis paradigm. - Defined and discussed technique - Added a critical feature activity. - Deleted an activity from the unit on indirect and direct constraints.
Observation	0 hours	
Diagnosis	- 2 hours	- Decreased the amount of time allowed for completion and the discussion of the activities.
Remediation	- 1 hour	- Decreased the amount of discussion time.

SUPPLEMENTARY LEARNING AND UNINTENDED EFFECTS

The subjects were exposed to a series of tests designed to examine the suitability of the changing criterion design. Throughout the implementation of these tests the investigator was required to withhold information and refrain from providing feedback. Despite the unsuitability of the design and the negative reactions which were expressed by the subjects, the subjects were inadvertently sensitized to the significance of identifying the critical features in a performance. The final section of the movement analysis instructional unit appeared to effect a noticeable impact on the subjects' understanding of the conceptual analysis process. Subjects immediately adopted the term "critical features" and many relayed experiences which highlighted their appreciation for the need to focus on the critical features in a performance. Similar results were observed following the testing periods implemented during the planning for observation stage.

Prior to the initiation of the PFT the criteria for the selection of the sample were determined. Theoretically, skill analysis viewed as a totality is a process which may be applied to the analysis of any skill or movement. Since the approach to skill analysis was developed as a generic process no attempt was made to control for the subjects' type of sport or movement backgrounds. The sample which resulted was extremely diverse in their movement experiences and interests. It is the belief of the investigator that the diversity of the group augmented the impact of the skill analysis paradigm. In particular, the many discussions that ensued from the instruction and practical experiences highlighted the universality of the skill analysis paradigm to all participants.

Many of the subjects in the PFT initially expressed anxiety over the reliance of the skill analysis paradigm on the understanding of biomechanical principles. The study of biomechanics in the undergraduate physical education curriculum and teacher preparation programs appears to have been approached as a subject area unrelated to the practice of coaching or teaching skills. Possible explanations for this approach were discussed in Chapter II. Following the completion of the training program subjects expressed an appreciation for the need to integrate the disciplines.

> I am pleased to have gained the exposure to a link between biomechanics and teaching. This crossdisciplinary process of the application of biomechanics will benefit both teachers and coaches. (Subject Two)

> My mind is now working, thinking how this course can improve my abilities as a teacher and a coach and how I can put this to use. The traditional kinesiology as described by Hoffman, was a very interesting course as I took it in my undergraduate degree. I really enjoyed biomechanics even though my math and physics were weak. However, I never once thought about if I ever used it in the teaching of skills or in the analysis of skills. I now realize the importance of going beyond the mechanical principles. (Subject Six)

SUMMARY OF THE ACTIONS TAKEN AS A RESULT OF THE PFT

The purpose of the preliminary field test was to obtain information regarding the implementation of the skill analysis training program and the effectiveness of the skill analysis paradigm. Based on the results of the study the following revisions were incorporated into the final field test.

1. The skill analysis paradigm was modified to address the indirect and direct constraints on the observation process prior to the development of an observation plan. In addition the stage was renamed to highlight two distinct target goals; a) the identification of factors that alter the perception of movement, and b) the determination of other relevant correlates. The revised skill analysis paradigm is presented in Figure 12.
2. The instructional unit which focused on the determination of an acceptable response range was moved to follow the development of an observation plan instructional unit, prior to the completion of the video project.
3. A biomechanics test was developed to collect information regarding the participants initial biomechanics entry status.
4. The structure and content of the introductory instructional unit was revised to include initial participant introductions and an activity which determined what the course participants considered skill analysis to be. The review of the literature which focused on past attempts to train skill analysis was moved to follow the presentation of the Qualititative Analysis videotape. A simplified version of the skill analysis paradigm

depicting only the target goals in each phase replaced the original skill analysis handout.

5. The introductory mini-lecture in the Movement Analysis stage was expanded to include a reference to the skill analysis paradigm, an overview of each of the steps included in this stage of the process, and the provision of information regarding the significance and definition of critical features. Definitions for the terms to be used in the development of a theoretical model were developed. A detailed model of the movement analysis phase was added to the resource package.
6. The number of skills used in the activities on the first two steps of the movement analysis phase was increased to provide greater opportunity for practical application. A brief description of the example skills was provided in order to reduce ambiquity concerning the objective of each of the skills.
7. The time component devoted to the completion and discussion of the learning and practice activities associated with the identification of critical features was increased.
8. The instructional unit dealing with the development of an observation plan was revised to include more initial information on the significance and description of an observation plan, references to the skill analysis paradigm, and more information and examples on the identification of predictive features and the selection of the optimal number of observations. A detailed model of the planning for observation phase was added to the resource package.
9. The instructional unit associated with the diagnosis phase was expanded to include a greater number of examples and the provision of more time to practice the identification of primary errors.
10. A total of nine hours was added to the time requirements of the training program to provide students with an opportunity to apply the skill analysis paradigm to the analysis of three new skills. A resource package which included descriptions and diagrams of these three skills was compiled. The total training program time requirement was increased from 27 hours to 37 hours to allow for the expanded instructional units and the provision of the nine hour practical component.

11. A single subject multiple baseline research design across behaviors was developed to be applied during the final practical assignment. The rationale for the inclusion of an empirical test was the need to assess objectively any changes on skill analysis competency that may have resulted from the application of the skill analysis paradigm. The changing criterion design was considered unsuited to the testing of the skill analysis intervention package.
12. All other aspects of the skill analysis paradigm, training program, and the implementation format and procedures were retained for the final field test.

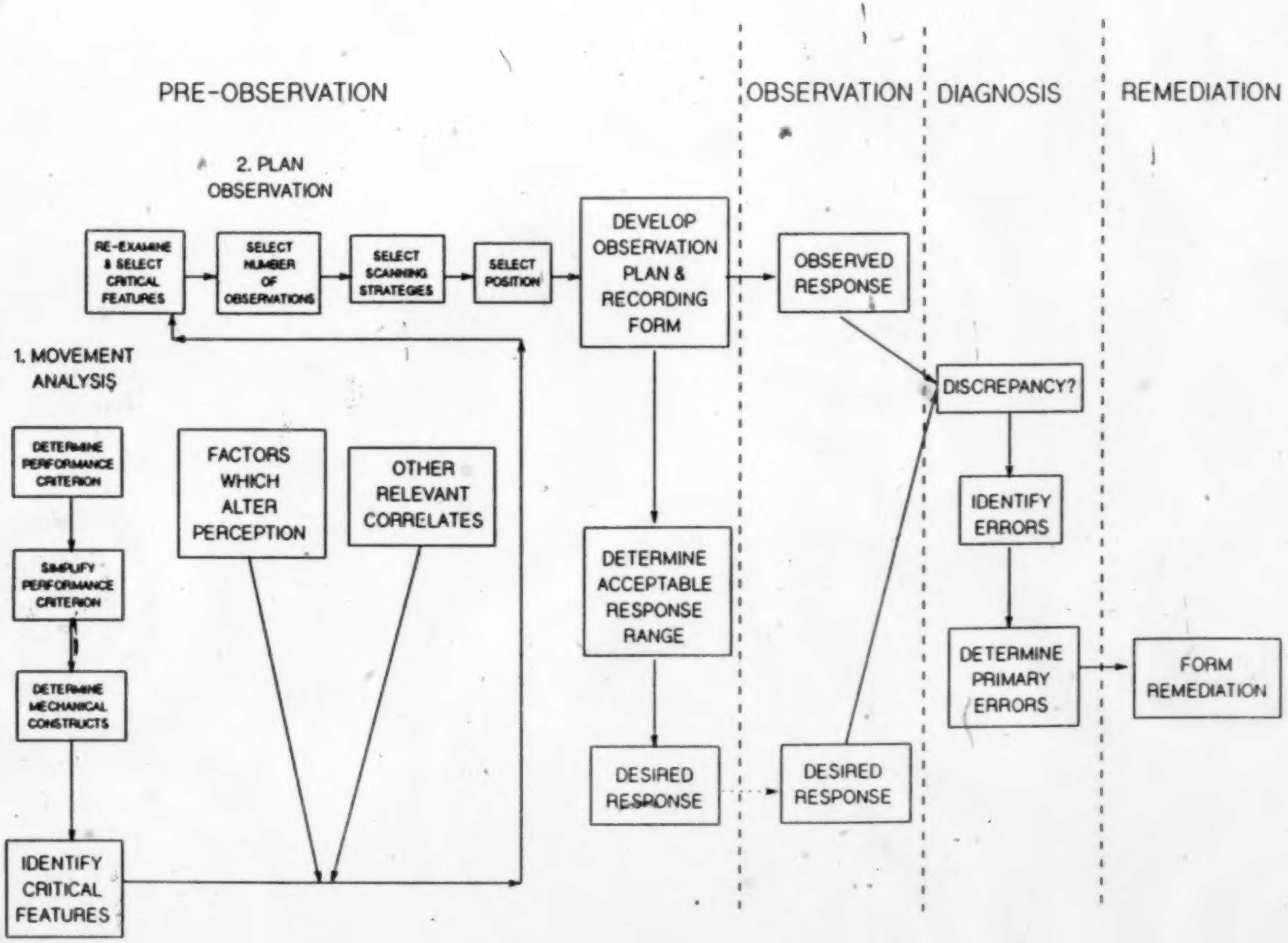

PRE-OBSERVATION
OBSERVATION
DIAGNOSIS
REMEDIATION
2. PLAN OBSERVATION
RE-EXAMINE & SELECT CRITICAL FEATURES
SELECT NUMBER OF OBSERVATIONS
SELECT SCANNING STRATEGIES
SELECT POSITION
DEVELOP OBSERVATION PLAN & RECORDING FORM
OBSERVED RESPONSE
1. MOVEMENT ANALYSIS
DETERMINE PERFORMANCE CRITERION
SIMPLIFY PERFORMANCE CRITERION
DETERMINE MECHANICAL CONSTRUCTS
IDENTIFY CRITICAL FEATURES
FACTORS WHICH ALTER PERCEPTION
OTHER RELEVANT CORRELATES
DETERMINE ACCEPTABLE RESPONSE RANGE
DESIRED RESPONSE
DESIRED RESPONSE
DISCREPANCY?
IDENTIFY ERRORS
DETERMINE PRIMARY ERRORS
FORM REMEDIATION

Figure 12. A Paradigm for Skill Analysis

Chapter VII

THE FINAL FIELD TEST

DEVELOPMENT OF THE FINAL PRACTICAL ASSIGNMENT

The results of the Preliminary Field Test indicated that subjects felt that the skill analysis training program lacked opportunities for guided practice sessions. In order to maintain the continuity of the paradigm the main example skills were retained throughout the training program intervention. One of the premises of the skill analysis paradigm was that skill analysis is a process which requires the systematic application of each of the skill analysis components. The quality of each phase is dependent upon the quality of the previous one. Therefore, in order to provide the participants with a realistic and practical experience, the extra sessions were structured so as to allow for the sytematic application of the skill analysis model from start to finish. Consequently, a nine hour final practical assignment was developed and added to the program requirements.

The completion of the last instructional unit was followed by three, three hour sessions of practicing, in a controlled environment, the application of the skill analysis paradigm to three new skills. The skills were chosen on the basis of the responses provided on the subject vitas. The investigator attempted to select skills with which the subjects had minimal experience as teachers, coachs, officials, spectators, or participants. A resource package was developed for each skill which included exerpts from coaches manuals, skill descriptions, diagrams, and drawings.

DEVELOPMENT OF THE BIOMECHANICS ENTRY LEVEL STATUS QUIZ

A paper and pencil quiz was developed in order to determine an initial measure of the participants theoretical competency in the area of biomechanics (see Appendix 7: Biomechanics Quiz). It was the belief of the investigator that the test would furnish information which would enhance the final assessment of the skill analysis training program. The test was prepared to be completed immediately following the implementation of the biomechanics refresher session. The material chosen for inclusion in the evaluation was based on the terms, concepts, and principles on which the NCCP Theory Skill Analysis chapters were structured. Several components of the test were adapted from the NCCP level three review activity and the final skill analysis competency test.

The test consisted of 12 multiple choice questions, 7 short answer questions, and 15 questions which required the application of the mechanical principles to a selection of skills. The purpose of the test was to test the subjects' knowledge of common terms and their understanding of principles and generalizations, as well as to test their ability to apply principles to the analysis of a number of different skills.

The subjects were told the quiz was merely a review activity designed to give the instructor some indication of the amount of biomechnics knowledge they had retained. Each quiz was marked out of a total of 50 and converted to a percentage score. The tests were returned to the subjects with corrections made, however, the subjects were not provided with the percentage score.

DESCRIPTION OF THE TRAINING PROGRAM

The development and arrangement of the components of the skill analysis training program were described in Chapter IV. A detailed description of the objectives, outlines, as well as the activities, handouts, and overheads for each session of the FFT is presented in Appendix 8: FFT Skill Analysis Training Program.

DETERMINATION OF THE FIELD TEST FORMAT

Based on the results of the PFT the following criteria for the final field test format were determined:

1. A minimum of 37 hours was required to cover the revised modules and the practical assignment.
2. The implementation of the training program during a university course which spanned approximately five weeks and allowed for repeated exposure to the material was desired.

3. The subjects chosen to participate in the Final Field Test should have a strong background in Physical Education which included exposure to the area of biomechanics, previous teaching or coaching experience, and an interest in the skill analysis process.
4. The format should provide participants with a university credit.

Permission to field test the skill analysis training program as a Senior undergraduate course entitled *Strategies for the Observation and Analysis of Motor Skills* was obtained from the Department of Secondary Education. The Department stipulated that the course be conducted within the normal timelines of the Fall term and that the course provide a minimum of 35 hours of instruction.

SUBJECTS

The Final Field Test was based on the information obtained from seven subjects between the ages of 21 and 35. All of the subjects met the investigator's requirements regarding background and previous experience in Physical Education, teaching and coaching, exposure to the area of biomechanics, and an interest in the skill analysis process. Three of the subjects were 4th year undergraduates in Physical Education with a special interest in coaching. Two of the subjects had previously completed a Physical Education degree and were currently enrolled in the Education Faculty. The remaining subject was a Junior High School Physical Education teacher and a previous graduate of the University of Alberta. All subjects had completed the introductory biomechanics course offered in the Department of Physical Education and all but one had completed Level 2 of the NCCP Theory Program. A summary of the relevant experiences and background of each of the subjects is presented in Table 3.

Table 3. Final Field Test Subject Information

	SUBJECT ONE	SUBJECT TWO
Post-secondary Education	- B.PE (Athletic Training & Conditioning)	- B.PE (4th year Coaching) - B.ED Completed one year
Related Course Work	- Intro. Biomechanics, Kinesiology, Functional Anatomy	- Intro. Biomechanics, Kinesiology, Functional Anatomy - Advanced Biomechanics
NCCP Certification	- Level 1 Technical: Volleyball	- Level 1 Technical: Tennis, Soccer, Baseball - Level 2 Technical: Gymnastics, Hockey
PE Teaching Experience	- High School Student Teaching	- N/A
Coaching &	- High School Volleyball	- Recreational &
Instructing Experience	- Recreational Racquetball	- Competitive-Gymnastics - Club Hockey - Recreational Tennis - Club Track & Field
Officiating Experience	- Volleyball Referree	- Hockey Referree - Gymnastic Judge
Activities With Which Most Familiar	1. Volleyball 2. Fitness Activities 3. Swimming 4. Golf 5. Basketball	1. Gymnastics 2. Tennis 3. Volleyball 4. Soccer 5. Hockey

Table 3. Continued

	SUBJECT THREE	SUBJECT FOUR
Post-secondary Education	- B.PE (4th year Coaching	- B.PE - B.ED (Completed 1 year)
Related Course Work	- Intro. Biomechanics, Kinesiology, Functional Anatomy	- Intro. Biomechanics, Kinesiology, Functional Anatomy
N.C.C.P Certification		- Level 2 Technical: Basketball
PE Teaching Experience	- N/A	- High School Student Teaching
Coaching & Instructing Experience	- High School Basketball	- High School Volleyball - High School Basketball
Officiating Experience		- Volleyball Referree - Basketball Referree
Activities With Which Most Familiar	1. Basketball 2. Volleyball 3. Softball 4. Floor Hockey 5. Dance	1. Basketball 2. Volleyball 3. Track & Field 4. Baseball 5. Football

Table 3. continued

	SUBJECT FIVE	SUBJECT SIX
Post-secondary Education	- B.PE (Athletic Training & Conditioning)	- B.PE (4th year Coaching) - B.ED (Physical Education)
Related Course Work	- Intro. Biomechanics, Kinesiology, Anatomy - Advanced Biomechanics	- Intro. Biomechanics, Kinesiology, Functional Anatomy
NCCP Certification	- Level 1 Technical: Volleyball, Hockey, Basketball - Level 2 Technical: Badminton, Swimming - Level 2 Theory	- Level 2 Technical: Hockey - Level 2 Theory
PE Teaching Experience	- Junior High School (5 years)	- N/A
Coaching & Instructing Experience	- High School Volleyball Soccer, Cross-country, Basketball, Badminton, Baseball, Swimming, Wrestling, Team Handball, Weight Training	- University Track & Field - Club Hockey
Officiating Experience	- All Junior High School Sports - Referree	
Activities With Which Most Familiar	1. Volleyball 2. Swimming 3. Basketball 4. Badminton 5. Hockey	1. Track & Field 2. Hockey 3. Soccer 4. Rugby 5. Football

Table 3. Continued

SUBJECT SEVEN	
Post-secondary Education	- B.PE (4th year Coaching)
Related Course Work	- Intro. Biomechanics, Kinesiology, Functional Anatomy
NCCP Certification	- N/A
PE Teaching Experience	- N/A
Coaching & Instructing Experience	- High School Basketball, Soccer, Swimming
Officiating Experience	- Volleyball Referree
Activities With Which Most Familiar	1. Swimming 2. Basketball 3. Soccer 4. Floor Hockey 5. Volleyball

Despite the subjects' previous exposure to the area of Biomechanics, the investigator decided to initiate the course with the six hour refresher session developed for the PFT. This decision was based on the need to ascertain that all subjects had an initial basic level of knowledge in the area. The biomechanic review was not considered part of the skill analysis training program and consequently its evaluation was not one of the objectives of this study. The inclusion of the biomechanics refresher session increased the time requirement of the course to 45 hours.

Based on the feedback obtained during the initial meeting with the participants a decision was made by the investigator to conduct the course from November 1, 1986 to December 3, 1986. Specific dates and times were subsequently selected (see Appendix 9: FFT Course Schedule).

FIELD TEST PROCEDURE

On Tuesday, November 4, 1986, the field test was initiated with a 75 minute *Welcome to Strategies for the Observation and Analysis of Motor Skills* Session. The first instructional unit was implemented on Day 2 of the program. The following two three hour sessions were devoted to the biomechanics refresher sessions. The assignment of the "Biomechanics: Entry Level Quiz" concluded the review sessions. On Tuesday, November 11, the second instructional unit which focused on the first stage of the pre-observation phase was presented. Instructional units were sequentially introduced each session until November 27. The final nine hours of the training program were devoted to the practical assignment. The course was concluded on December 3. A schedule which details the FFT implementation of the instructional units and the practical sessions is included in Appendix 11: FFT Course Schedule.

DATA GATHERING, EVALUATION, AND ANALYSIS PROCEDURES

EVALUATION DESIGN: The multiple baseline research design with probes was chosen for its potential for achieving internal validity without reversing the behavior of interest back to pre-intervention levels. In instances where a strong a-priori assumption of stability can be made, or where the use of extended baselines may be reactive or impractical, the multiple probe technique has been recommended (Horner & Baer, 1978). The use of the multiple probe technique to minimize the possible deleterious effects of repeated test trials during baseline conditions was considered essential in this investigation. Continuous testing would be highly impractical in terms of the amount of course time devoted to experimental evaluation. Furthermore, the extended baseline testing technique may have resulted in fatigue and decreased motivation levels. Based on the results of the review of the literature a strong apriori asssumption of baseline stability appeared justified. Analytic competency appears to be a movement specific behavior that demonstrates improvement only after a period of training or prolonged experience.

A single subject multiple baseline research design with probes was used to evaluate the relationship between the intervention and change in skill analysis competency. The ultimate criterion for judging the effectiveness of the skill analysis paradigm was the existence of a positive change in skill analysis competency. A measure of skill analysis competency was determined to be the ability to identify errors and determine the primary errors in a performance. This was based on the contention that participants who were able to determine primary errors would, as a normal extension of that ability, be able to form a remediation. The measurement of skill analysis competency at the Diagnosis phase of the paradigm provided the potential for a more objective assessment of skill analysis than would measurement at the Remediation phase.

The research design was used to evaluate each subject's ability to identify errors and determine primary errors from video-taped performances of the gymnastic squat vault, one-foot edging, and the lacrosse overarm pass. The dependent variable was the ability to identify errors and determine primary errors. The independent variables in the study were two, three hour guided practical sessions in which the skill analysis paradigm was applied firstly to the analysis of the gymnastic vault, and secondly to the analysis of the skating skill. The treatment was not applied to the lacrosse overarm pass due to time constraints. A causal relationship between the intervention and the dependent variable was demonstrated if the subject's performance changed when, and only when, the intervention was introduced. The baseline phase of the study measured the subject's ability to identify errors and determine the primary errors from the video-taped performances of three different skills. The post-intervention phase measured the subject's performance on the dependent variable following the sequential application of the skill analysis paradigm to each of the skills.

SELECTION OF THE TEST SKILLS: The vault, one-foot edging, and the overarm lacrosse pass were selected based on their suitability as closed skills with which the participants in the study had limited experience as observers or analysts. Following the selection of the three skills to be used in the research design, a theoretical model (Hay & Reid, 1872) was developed for each of the skills and the critical features were identified.(See Appendix 10: Theoretical Models). The information needed to conceptually analyze these skills was derived from a review of the relevant literature and gleaned through discussions with experts in the field.

DEVELOPMENT OF THE TEST TAPES: Four test tapes were assembled from a selection of performances of the gymnastic squat vault, one-foot edging, and the lacrosse overarm pass. The performances selected for the test tapes were chosen from a total of 28 high school student performances of the vault, 38 university student performances of the skating skill, and 34 high school student performances of the lacrosse pass. For each performance students were requested to perform the skill to the best of their ability. Student performances on each of the tapes within each skill demonstrated a range of skill proficiencies. The performances were selected to include examples of skills which varied in terms of the frequency, magnitude and types of errors.

The skills were recorded using a Sony Video Camera. A unique feature of this system was a rotating shutter which resulted in the production of an image with a 1/500 exposure time equivalent. The result was a very clear image with minimal blur between frames. Slow motion and freeze frame analysis allowed for the visual inspection and verification of the primary and secondary errors in each of the performances. A list of the validated errors for each performance was subsequently compiled.

A total of 33 student performances were placed on the test tapes to fit a single subject multiple baseline design session by session (Kniffen, 1985). The number of performances of each skill were selected on the basis of the criteria of the probe design outlined in Chapter II. Each single performance measure was referred to as a probe. Therefore, the first test tape included four probe measurements of the vault, three probe measurements of the skating skill, and two probe measurements of the lacrosse pass. Tape #2 included five measurements of the vault, four probe measurements of the skating skill, and three probe measurements of the lacrosse pass. The third test tape included three probe measurements of the vault, five probe measurements of the skating skill and four probe measurements of the lacrosse pass. Table 4 presents a breakdown of the number of performances of each skill placed on each test tape.

Table 4. Number of Probe Measurements of Each Skill on Each of the Test Tapes

TEST TAPE #	SKILL #1	SKILL #2	SKILL #3	TOTAL
1	4	3	2	9
2	5	4	3	12
3	3	5	4	12
TOTAL	12	12	9	33

EXPERIMENTAL PROTOCOL: Prior to the start of each testing session the subjects were given a chance to become familiar with the surroundings and objectives of the session. Subjects were provided with an instruction sheet that stated:

Following the three observations of each trial:

1. List the errors.
2. Beside each error indicate whether it is a primary error or a a secondary error.
3. If it is a secondary error state the primary error.

Under test conditions the subjects viewed three instant replays of each performance projected at normal speed onto a 20 x 30 foot screen. The subjects were given three minutes in which to identify and record their responses in the booklets provided. Prior to each projection of a skill performance the type of skill and the replay number was announced. The investigator did not provide any feedback on any of the subjects' performances following any of the test sessions.

INTERNAL & EXTERNAL VALIDITY: Internal validity refers to the degree of certainty that the manipulation of the independent variable is responsible for the observed changes in the dependent variable (Kratochwill, 1978, p. 11). Possible threats to the internal validity of a multiple baseline across behavior design were identified from the literature and included; history, maturation, testing, instrumentation, instability, change in unit composition, and reactivity. The study under investigation is discussed in view of these threats.

The effects of history and maturation were not considered to be a threat to the internal validity of this study. The multiple baseline design reduced the effects of history by the inclusion of different baselines and by implementing the interventions at different periods in time.

The effects of instrumentation were reduced by using slow motion and freeze frame analysis to validate the presence or absence of any errors in the video-taped performances. Measurement of the dependent variable was determined by a comparison of the subjects' responses on each probe measurement to the list of validated errors for that probe.

Furthermore, considerable care was taken to maintain the consistency of the testing procedures and assessments throughout the experiment.

Instability also posed a possible threat to the internal validity of this study. Large data fluctuations, particularly during the baseline conditions, can make the evaluation of the intervention very difficult. The determination of strong a-priori estimate of baseline stability was initially established in order to incorporate the multiple probe technique and therefore minimized this concern.

Testing effects through reactive measures occur when the measurement process itself is a stimulus for a change in the dependent variable. The incorporation of the multiple probe technique reduced testing effects by eliminating the need for continuous measurement. In addition, the testing context was very similar to the context in which the subjects had applied components of the skill analysis paradigm throughout the training program.

Neither reactive intervention nor changes in the experimental unit composition were considered to be a significant threat to the internal validity of this investigation. Both the baseline and intervention phases of the study were on a strict schedule. The deliberate application of the intervention precluded reaction to post or impeding changes in the baseline data. The likelihood of any absence from the practical assignment was minimized by a heavy weighting on the subject's total course grade. In any case, the subjects received the same instruction regardless of the group composition.

The external validity is defined as the extent to which the results of the study can be generalized to other individuals, interventions, situations, or behaviors. Questions are frequently raised with regards to population generalization of single subject designs. "The subject being investigated cannot be considered to represent a random sample of some larger population. Even if an assumption was made, there are not valid statistical procedures which permit scientifically sound generalizations to be made" (Schutz & Goodman, 1982, p. 44).

Although the results of this study may provide suggestive evidence that the intervention is worth applying to other populations, the findings of this study may only be generalized to a similar group of subjects. An attempt to increase the generalization of the results was made by applying the same procedures to a number of different subjects. Direct replication of the effects with seven subjects significantly increased the potential for the external validity of this study.

Ecological validity refers to the extent to which situations compared in the experiment are representative of the situation to which the investigator wishes to generalize (Kratochvill, 1978). Pertinent to the ecological validity of this study was the potential for generalization of effects to other behaviors or settings. The criteria for skill analysis competency was the ability to determine primary errors for the video-taped performances of four skills. Clearly, this behavior, assessed in a simulated context, represented only an indirect indicator of the subjects' analytic ability in the clinical situation. Unfortunately the need to assure veridical judgement of the dependent variable, and the inability to adequately control and assess in the real life context precluded the optimization of the ecological validity.

> By assessing analytic proficieny in a simulated context the investigator is able to control the range and frequency of performance errors played, thus ensuring standardization of assessment conditions. (Hoffman, 1977, p. 5)

Schutz & Goodman (1982) state that generalization to other behaviors may be made if there is a high degree of congruency between the tested behavior and the one to which the generalization is to be made. Kniffen (1985) found that the ability to identify critical features and visually discriminate these features as correct or incorrect generalized from a simulated setting to the real school gymnasium setting. However, hypotheses as to whether the results of this study would have generalized are purely speculative in nature.

Kratochwill (1978) identified ten factors which may pose a threat to the ecological validity of the multiple baseline design. Instability due to an incomplete or vague description of the independent variable was not considered to be a threat. One of the objectives of the study was the development of the independent variable. Consequently, the components of the independent variable were clearly defined and described in detail throughout the development and implementation of the training program.

Due to the imposed constraints of the testing timeline and protocol it is unlikely that the Hawthorne effect or pre-test and posttest sensitization evoked any significant threats. The effects of interaction of time of measurement and intervention, as well as of the interaction of history and intervention were attenuated first, by repeated testing of the dependent variable and secondly, by testing following the completion of the intervention. The decision to focus on the target goal from the diagnosis phase of the skill analysis process as a measure of skill analysis competency was based on the need to identify an objective dependent variable. The measurement of the dependent variable was deemed both valid and reliable.

The referent generality, or range of possible outcomes for this study, was very small. The application of the single subject multiple baseline design examined only the relationship between the intervention and skill analysis competency as measured by the ability to determine primary errors.

A definite weakness to the ecological validity of this study ensued from the effects of experimentor bias. The investigator was intimately involved as the writer, developer, coordinator, supervisor, and evaluator of the study. The extent to which the investigator affected the performance of the subjects is indeterminable within the context of this investigation.

ANALYSIS OF THE RESULTS OF THE SINGLE SUBJECT MULTIPLE BASELINE RESEARCH DESIGN

The performances on each probe measurement were examined to determine the number of correct responses for both the identification of errors and the determination of primary errors. Measurement of the dependent variable was determined by a comparison of the subjects' responses on each probe measurement to the list of validated errors for that probe. Each score was then divided by the total number of errors in that particular performance and multiplied by 100 to calculate the percentage of correct responses. The data were displayed graphically over the course of the baseline and postintervention conditions. The means scores for both the intervention and baseline phase of each skill were calculated. In addition, trend lines were fitted to the data by the least squares method (Parsonson & Baer, 1978). Differences between the phases were visually inspected for observable changes in level, mean, variability, and trend.

SUMMATIVE EVALUATION AND ANALYSIS OF THE TRAINING PROGRAM

In an attempt to acheive a thorough summative evaluation of the skill analysis training program, a multi-faceted approach to data collection and evaluation was adopted. Wolf (1979) stated that in order to evaluate a course and provide information that will lead to the improvement of the instructional effort the following five classes of information need to be addressed; initial status of the learners, learner performance after a period of instruction, execution of the treatment, costs, and supplemental information. In order to obtain information in the five classes outlined by Wolf (1979), seven primary sources were identified. These included the completion and discussion of assigned group and individual activities, an assigned small group project, daily and summary journal entries, investigator daily journal entries, investigator's informal observations, a paper and pencil biomechanic quiz, and a final practical assignment. With the exception of the paper and pencil biomechanics quiz and the experimental research design discussed in the previous section, all information gathering tools were successfully piloted in the PFT. A detailed description of each of these sources of information is provided in Chapter V. A summary of the data gathering tools and the analysis techniques associated with each of the five major classes of information are presented below.

1. *Initial Status of the Learner*: Information collected via a subject vita determined the initial status of the subjects with regard to their experience and exposure to the skill analysis process. The material was examined and summarized by the investigator. A paper and pencil test, assigned immediately following the Biomechanics refresher session, was used to determine a measure of the subjects' initial theoretical competency. Each quiz was graded and a score out of 100 determined.
2. *Learner Performance Following a Period of Instruction*: The learner's performance after instruction was evaluated first by the achievement of the learner objectives associated with the skill analysis target skills. The tools which were used to evaluate each learner objective are presented in Figure 13. The participants' responses to each of the assigned activites were discussed and recorded. Any inabilities to complete a task, or component of

the task, were noted. A subjective evaluation of the group projects was made by the investigator as outlined in Chapter V. A descriptive analysis of both the subject and investigator daily and summary journal entries was completed to furnish additional qualitative information about the achievement of the learner objectives. Evaluation using a single subject multiple baseline research design was undertaken during the practical assignment to furnish information regarding the learner's performance following the application of the skill anlysis paradigm. The data was displayed graphically and visually analyzed for observable changes in the intervention and baseline phases.

3. *Execution of the Treatment*: Monitoring the implementation of the treatment involved gathering information concerned with the way in which the program was carried out. An analysis of the daily journal entries and investigator observations provided a comparitive check between the theoretical study and the planned training program.
4. *Cost:* A record of the costs, both temporal and monetary, associated with the development and implementation of the training package was maintained. Any costs related to the research design were maintained separately. Following completion of the course the totals were calculated and used to consider the social validity of the training program intervention.
5. *Supplemental Information*: Supplemental information such as reactions, opinions, concerns etc... was gathered from the subjective analysis of subjects' journals, investigator journals, and informal discussions.

THE SYNTHESIS OF INFORMATION NEEDED TO ADDRESS THE STUDY RESEARCH QUESTIONS

Following the collection of the five classes of information, the results were synthesized. The final assessment of the skill analysis paradigm and the training program was made with respect to the main research questions stated in Chapter I.

LEARNER OBJECTIVE	ACTIVITY	TAKE HOME	VIDEO PROJECT	PRACTICAL ASSIGNMENT	SUBJECT JOURNAL	INVESTIGATOR JOURNAL
IDENTIFY CRITICAL FEATURES	*		*	*	*	*
IDENTIFY FACTORS WHICH ALTER PERCEPTION			*	*	*	*
IDENTIFY OTHER RELEVANT CORRELATES			*	*	*	*
DEVELOP OB. PLAN RECORDING FORM	*	*	*	*	*	*
DETERMINE ACCEPTABLE RESPONSE RANGE		*	*	*	*	*
ADOPT OB. STRATEGIES			*	*	*	*
IDENTIFY PRIMARY ERRORS	*		*	*	*	*

Figure 13. Tools used to Evaluate the Learner Objectives

1. Did the training program evoke a positive change in skill analysis competency?

The ability to identify primary and secondary errors was identified as a measure of skill analysis competency. The application of the single subject multiple baseline resarch design to the final practical assignment provided the information necessary to address this question.

2. Was packaged intervention successful in changing teacher/coach analysis skills?

The appropriateness of the treatment was determined in view of its experimental and therapeutic criterion. The experimental criterion was determined from information derived from the empirical test of skill analysis competency. The therapeutic criterion addressed the applied significance of the intervention. The information needed to address this criterion was derived from the subjects' and investigator's journals, achievement of the learner objectives, and the cost analysis.

3. Was the training program a functional means of building analysis skills?

The practical implementation of the training program, as well as its success in founding analysis skills, was determined through an analysis of the results from the final practical assignment, completion of class activities, and the recorded and summary entries made in the subjects' journals.

4. What variables impacted on the intervention procedures?

The source of information which recorded modifications that were made during the implementation of the training program, or that expressed problems or concerns with the training program, were the subjects' and investigator's journals, and informal observations and discussions.

5. What are the difficulties, constraints etc... involved in training Physical Education students, coaches, and teachers to analyze performances of gross motor skills?

The analysis of both the subject and investigator journals from both the PFT and the FFT furnished the information needed to address this question.

Chapter VIII

ANALYSIS OF DATA AND DISCUSSION OF RESULTS

The purpose of the final field test was to implement and evaluate a training program designed to promote teacher and coach skill analysis competency. Seven subjects were exposed to the intervention procedures described in Chapter VII. In addition, a single subject multiple baseline research design was used to determine the efficacy of the relationship between the application of the skill analysis paradigm and a change in skill analysis competency.

An analysis and discussion of the findings are presented under the following headings: (a) initial status of the learner, (b) learner performance following a period of instruction, (c) execution of the treatment, (d) cost, and (e) supplemental information. The final section of this chapter is devoted to the synthesis and discussion of results as they relate to the research questions that were identified in Chapter I.

INITIAL STATUS

A summary of the initial status of each of the subjects with regard to their teaching, coaching, participant, and officiating experiences, as well as their previous exposure to biomechanics and skill analysis as subject areas, was presented in Table 3. An analysis of the results highlighted the extensive sports involvement of each of the participants in the study. All of the subjects were active as coaches of recreational or competitive athletes. During the course of the study Subject Two and Subject Six were coaching at the University level. Only three of the subjects had any previous teaching experience. For Subject One and Subject Four the teaching experience consisted of a four week student practicum. Subject Five was employed as a full time Junior High School Physical Education teacher. All of the subjects had completed a one semester course in Biomechanics, Kinesiology, and Functional Anatomy at the University of Alberta. In addition, Subject Two and Subject Five indicated that they had also completed the University of Alberta advanced biomechanics course. The subjects' responses to the biomechanics paper and pencil quiz were graded out of 50 and converted to a percentage score. The group average was 74% with a standard deviation of 17%. Table 5 presents the results grouped according to the various components of the quiz.

Table 5. Results of the Biomechanics Quiz

SUBJECT	MULTIPLE CHOICE /12	SHORT ANSWER /16	PRINCIPLES /22	TOTAL /50	%
1	10	16	20	46	92
2	12	15	22	49	98
3	9	11	17	36	72
4	10	12	19	32	64
5	10	13	2	25	50
6	9	12	11	32	64
7	8	11	12	31	62
MEAN	9.7	12.9	14.7	35.9	71.7
STANDARD DEVIATION	1.6	2.0	6.9	8.6	17.3

PERFORMANCE FOLLOWING A PERIOD OF INSTRUCTION

The learner's performance following a period of instruction was evaluated first by their achievement of the learner objectives associated with each of the skill analysis target skills. These findings are reported and discussed in relation to each of the learner objectives. The use of a single subject multiple baseline research design furnished additional information concerning the learner's performance on the analysis of novel skills following the application of the skill analysis paradigm.

IDENTIFICATION OF CRITICAL FEATURES

> I realize that the critical features are inflexible parts of a skill. Any modification to the critical features directly affects the performance...These features are the very thing a coach/teacher should be focusing on. I was also surprized that in the past I had been trying to correct errors that were not critical features they were in fact secondary to the fact or were an expression of style. (Subject Three)

As part of the movement analysis instructional unit each of the subjects was led in succession through a series of steps based on the Development of a Theoretical Model (Hay & Reid, 1982). The process culminated in the identification of critical features for four fundamental skills. Small group and class activities were associated with the determination of the performance criterion, the simplification of the performance criterion, the determination of the mechanical constructs, and the identification of the critical features. In addition, subjects were provided with the opportunity to integrate and apply the procedure involved in the identification of the critical features to two novel skills as part of the final practical assignment.

All of the subjects were able to complete the activities and final practical assignment. Several of the subjects indicated in their daily journal entries that they felt that some of the movement analysis steps were difficult and required additional practice. Subjects Three, Four, and Five all expressed some difficulty with the determination of the performance criterion for skills which were measured subjectively.

Subject Four was the only subject to state that the determination of the mechanical constructs presented a problem, although Subject One and Two both suggested that the ability to determine the mechanical constructs was highly dependent on an understanding of the theory and application of mechanical principles. The overall positive results of the biomechanics quiz and the previous experience of the participants would support the general lack of concern for the complexity of the task. However, by contrast, the investigator noted that the subjects appeared overwhelmed by the demands of determining the mechanical constructs. The results of the study provided no explanation for this discrepancy in the findings.

The first step in the practical assignment was the identification of the critical features for a novel skill. Each of the subjects made use of the resource materials provided and drew from the knowledge of the group expert in order to complete the movement analysis phase. The critical features were then pooled and discussed in the ensuing discussion. No problems or concerns were noted.

Subject One and Three stated that they now realized that in past analysis experiences they had often looked for the wrong things. Subjects One, Two, Three, Five, and Six all stated that they would incorporate the method that was presented in the training program for the identification of critical features in future analyses as it provided a clear and systematic approach to a task they considered key to the success of the coach.

IDENTIFICATION OF THE FACTORS WHICH AFFECT THE PERCEPTUAL PROCESS AND OTHER RELEVANT CORRELATES

> I believe it is very important to look at constraints because not everyone is built the same, thus, what might be possible for one person might not be possible for another. If you do not take into consideration individual differences, and recognize them, in some cases it will be very frustrating to the individual you are analyzing because they will never satisfy your expectations... An important point that the instructor brought up was that an individual can modify their style but they still include all the critical features when performing the skill. An example that comes to mind is when I am coaching the tennis serve to juniors. Many of them try to serve like John MacEnroe but what they are copying is not the critical features but instead his style.
> (Subject Two)

The second instructional unit, the identification of the indirect and direct constraints on an observation experience, was associated with the recognition of the factors which alter the observer's ability to perceive movement as well as the factors which place constraints on the performer. The instructional unit did not include any assigned activities but did involve the group in a guided discussion. None of the subjects expressed any difficulty understanding the material that was presented. All subjects participated in the discussion and provided relevant examples from their coaching experiences.

During the introductory mini-lecture the investigator requested that throughout the training program the subjects consider the suitability of dealing with the indirect and direct constraints immediately prior to the development of an observation plan. Both Subject One and Subject Two stated that the consideration of the factors which alter the perceptual process and the constraints on the performer should be dealt with immediately following the identification of the critical features. They felt that this step set the stage for the observation process.

Examination of the subject journal entries and the recorded observations of the investigator which focused on the video project and the practical assignment lent support to the subjects' achievement of the learner objective. All of the subjects indicated that they had considered possible constraints by their choices of the project design options. For example, Subject Two and Subject Four determined that an ideal contrast would be produced by dressing the performer in white and setting up a dark green background. Subject One expressed concern about the number of visual distractions that were present in the taping area. As deemed essential by Barrett (1979), the subjects recognized the need to shift their focus to the complexities of the perceptual process.

> With so many things in the backgound to throw the concentration off, it was also very important that we made sure that there were no signs in the way or vents on the wall, etc... that made the eye deviate from the performer. (Subject One)

Several of the subjects indicated that the test tapes also posed constraints on their perception and required that they make adjustments.

> The plan also prepared us for the constraints in the videotaping, for example we didn't see the approach so we had to adjust and prepare ourselves appropriately. (Subject Three)

DEVELOPMENT OF AN OBSERVATION PLAN AND RECORDING FORM

Subjects completed group, small group, and individual activites which addressed the examination and selection of critical features and predictive features, and the discussion of scanning and position strategies. The attainment of the learner objective was measured by the subjects' ability to complete the activities associated with each of the components of the plan and to incorporate these components into a specific observation plan.

Despite the revision and expansion of the section dealing with predictive features, the topic still provoked a mixture of positive and negative reactions. Only three of the subjects provided indications in their recorded journal discussions that they could use the identification of predictive features to facilitate perceptual organization. The following quote provided an example of how Subject One addressed the concept.

> Also I should not get too caught up in the predictive features of the performance and let them become apparent to me naturally...ie. don't go out of my way looking for them. There are many subtle and explicit things that may happen in a performance that I observe that will eliminate the necessity to watch any subsequent activity as the performance has been affected too much. I should then simply button my lip, refrain from feedback, and ask the performer to begin again. (Subject One)

Subject Two provided an interesting discussion which suggested that as a result of his analytic experience with gymnastics he was able to cue in on certain predictive features. The ability to detect predictive features became particularly important when he was forced to analyze a skill while simultaneously spotting the performer. The less than ideal viewing position made it impossible to observe the position of various body parts. Consequently, predictive features were identifed and observed to furnish information about the critical features. This ability supported the suggestion made by Newston (1976) that skilled observers may adopt monitoring priorities such that the appearance of a given feature indicates a critical feature is about to change.

Subject Three stated that the group activity which required the identification of the predictive features for the cartwheel actually helped to clarify the concept of critical features. Unfortunately, the subject does not provide any further explanation on how the activity served to clarify this concept.

Subject Four recorded that she experienced problems grasping the distinction between a predictive feature and critical feature. The investigator noted that Subjects Five, Six, and Seven appeared confused during the presentation and subsequent discussions. Examination of the journals for these subjects did not provide any additional insights.

Difficulties that were experienced throughout the presentation of this section during both the PFT and the FFT suggested that either the concept had not been effectively dealt with or it did not belong in the skill analysis paradigm. Whether the identification of predictive features is a topic that is more appropriate for a program designed to refine the analysis techniques of more experienced observers remains unclear.

The subjects demonstrated positive reactions to all other activities in the planning for observation instructional unit and were able to integrate the conponents during the development of an observation plan and recording form. Small groups of two and three worked together to develop an observation plan as part of the assigned video project. The decision to include a particular strategy or component in the plan was based on discussions among the group members and was subsequently justified to the class. An example of one of the observation plans and recording forms that was completed and distributed to the class is presented in Figure 14.

Each of the subjects discussed the impact that the observation stage had had on their understanding of the skill analysis process. Subjects One, Two, Three, and Five all stated that they would incorporate the approach in their future coaching experiences. Subjects Three, Four, and Seven stated that they initially found the development of an observation plan and recording form a confusing and time consuming task. The final practical assignment provided an opportunity for the subjects to develop observation plans for two additional skills. The additional practice opportunities were greatly appreciated and served to simplify the process.

The overwhelming positive response to the planning for observation stageof strongly supports the work of Barrett (1979). Barrett found after examining the responses of 30 undergraduate physical education students, that the principles of planning and positioning were considered paramount to the success of the observation process.

DETERMINATION OF AN ACCEPTABLE RESPONSE RANGE

The ability to determine an acceptable response range was gauged first by the completion and discussion of an assigned homework activity. Subjects were required to produce a pictorial representation of an acceptable response range for a number of different critical features. Both Subject Six and Subject Seven were unable to complete the activity on their first attempt. Subject Six explained that when he was analyzing a skill he had never

SKILL *Long Jump* **TASK** *To analyze the overall technique*

SETTING *Constraints = Baggy clothing & thick landing mats*

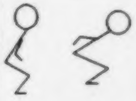
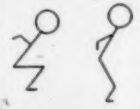
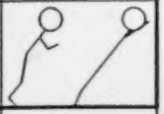
OBSERVATION NUMBER	CRITICAL FEATURES	PURPOSE	POSITION	SCANNING STRATEGIES	ACCEPTABLE RESPONSE RANGE
1	-All critical features	-To view whole skill	90 from midpoint	Scan entire skill	Skill completion
2	- Forward lean -Joint flexion at landing	-Take-off angle -Transfer of rotational momentum	90 from midpoint	Scan take-off & landing	
3	-Flexion at A/K/H/S - Extension at A/K/H/S	-Observe joint sequence & application of forces during take-off	90 from take-off distance=20'	Direct focus on take-off	
4	"	-Observe joint sequence & application of forces at instant of take-off	"	"	
5	-Lateral displacement	-Equal force application	Front view distance=20'	Direct focus on take-off & landing	Land with both feet parallel in plane of motion

Figure 14. Observation Plan & Recording Form

SKILL *Long Jump* **TASK** *To analyze the overall technique*

SETTING *Constraints = Baggy clothing & thick landing mats*

OBSERVATION NUMBER	RECORD OF PERFORMANCE	WITHIN RANGE		
		YES	NO	
1	Performed the complete skill	Yes		
2	For[illegible]rd lean within acceptable range	Yes		
	Flexion and extensions	Yes		
3	Flexion A/K/H/S	yes		
	Extension A/K/H/S	Yes		
4	Flexion A/K/H/S	yes		
	Extension A/K/H/S	Yes		
5	Lateral displacement within range	Yes		

considered the notion of a range of response, he always compared the observed response to an ideal.

> I found it hard to picture in my mind the range of response in a skill which I was familiar with. I could only picture in my mind what I thought to be the target or optimum response. I felt, and I am still not totally convinced, that you should not be shooting for the optimum performance. (Subject Six)

All of the analytic experience for Subject Six was centered on highly skilled athletes for whom he was attempting to make very small technique refinements. It is possible that he would approach the process quite differently were he to work with novice performers. During the discussion that followed Subject Six completed the activity producing a series of stick figure drawings that clearly indicated the determination of an acceptable response range. A copy of these drawings is presented in Figure 15.

Subject Seven stated that she had simply misunderstood the activity and offered no further explanation for her difficulties. The activity was subsequently completed and submitted.

One of the objectives of the instructional unit which focused on the determination of an acceptable response range was to stress that the formation of a mental image, which highlights the specific positions of critical features, may be an important determinant to the success of the analysis process. Examination of the journals indicated that this objective had been met. The comprehension of this objective was best expressed by Subjects Three and One.

> I also realized the importance of an acceptable response range. First, it is impossible to come up with an acceptable response range unless you have used mental imagery first. An acceptable response range is necessary for feedback. Basically, if you are trying to observe a skill and evaluate that skill, you must have a mental image of the critical features. (Subject Three)

> Through this activity the importance of a mental picture came through to me. It is of critical importance to make sure that the observer has a mental image of the skill and its stages and critical features, then assesses the performance against the picture which is an ideal or within an acceptable response range. (Subject One)

All subjects determined and discussed the acceptable response range they had selected in the assigned projects. Despite the provision of very little information regarding the performers who were used to demonstrate the skills in the final practical assignment, subjects still included an acceptable response range in the developed observation plans. The subjects

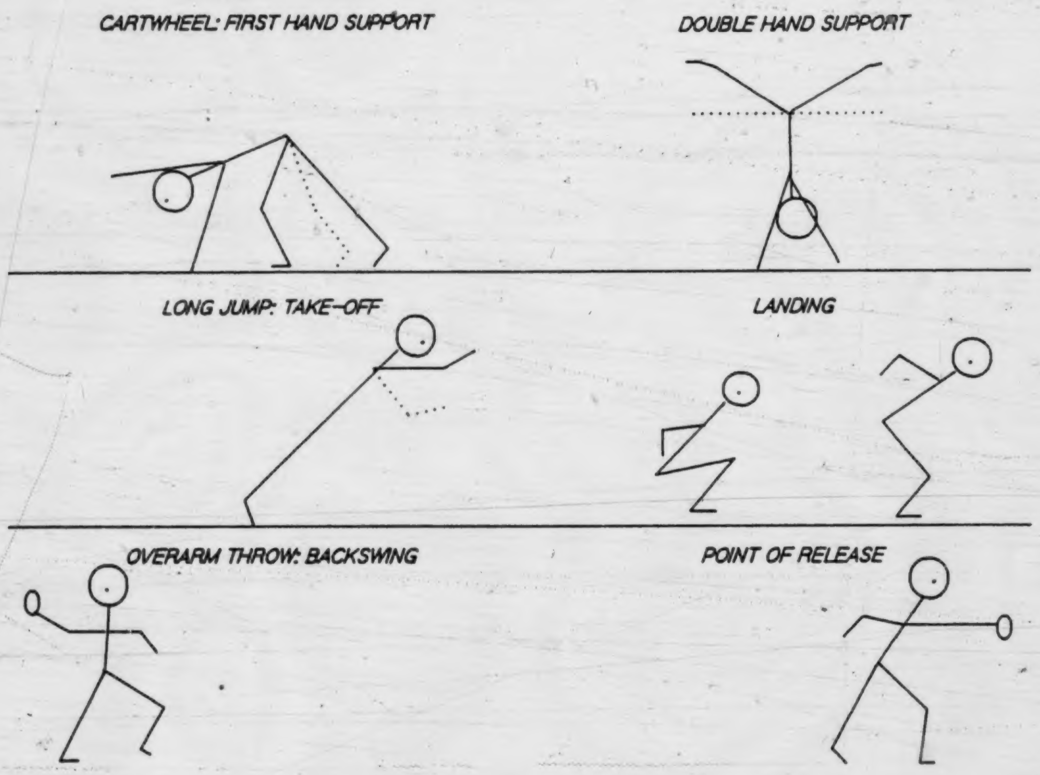


Figure 15. Acceptable Response Range

reactions to the practical experience provided additional proof that the objective had been internalized.

> I found that even though I had determined an acceptable response range for the squat vault, I raised and lowered my expectations throughout the different trials. I could tell that certain performers, even though they were not at a high level could do better and I found myself being a bit harder on these individuals. (Subject One)

Subjects One, Two, Three, and Four all indicated they would continue to pre-determine the acceptable response range in future analysis experiences.

ADOPTION OF OBSERVATION STRATEGIES

> I am actually applying much of what I have learned in my present experiences as a coach at Ross Shep. I find that I am going through the stages in the skill analysis model and keying in on the essential critical features. There used to be so many stimuli that I was trying to see. Now I simply key in on certain things, find the right angle and perspective for the viewing and watch a few times to make sure that what I am seeing is what I am seeing... making sure that there are no constraints that would interfere with my observation. (Subject One)

There is evidence to suggest that expert observers adopt monitoring and filtering strategies to extract the relevant information from the performance of a motor skill. Analysis of the completed group projects provided evidence that the subjects had adopted the observation strategies presented in the instructional unit. The purpose of the group video project was to develop an observation plan and recording form for an assigned skill then use the video camera to simulate the eye of the observer. Consider, for example, the following components of the observation plan developed for the cartwheel by Subject Four.

SKILL: Cartwheel

Critical features	Position	Scanning Strategy
1. Extension of the knee	Side View	Focus
2. Downward swing of arms	Front View	Focus

To adopt the observation strategies set out for the above critical features the video camera was first positioned at right angles to the plane of movement. The zoom control on the lens was used so as to focus only on the knee of the push off leg. The camera was then positioned facing the plane of motion. Again the zoom lens was used, this time to focus on the arms as they were swung down towards the mat. Through the presentation of the projects all of the groups demonstrated that they had adopted the observation strategies specified in their observation plans. Analysis of the journal entries associated with the final practical assignment provided additional support for the attainment of this learner objective.

IDENTIFICATION OF THE PRIMARY AND SECONDARY ERRORS

> One thing that I realized today was my past mistakes on feedback. I realized that I was trying to correct secondary errors (results of primary errors) instead of the crucial primary errors. For example, I would tell my athlete to put more backspin on the ball when shooting, the backspin however is a secondary errors. It results from a precurser of the wrist extension. (Subject Three)

Two activities were used to assess the ability of the subjects to identify primary and secondary errors. The first activity was a component of the Diagnosis instructional unit and required the participants to determine the discrepancy between the performance recorded for the video project and the desired response. Each of the subjects first determined the type of error according to the format described in the Hypothetico-deductive Decision Making Model (Hoffman, 1982). Any of the errors that were deemed to be a result of incorrect technique were further examined in order to determine the primary and secondary errors. While each of the groups were able to provide positive results on this task the subsequent analysis of the journals indicated that each of the subjects had experienced some initial difficulties. However, Subjects One, Two, Three, and Five all stated that the group activity was successful in solving their problems in understanding the distinction between a primary and secondary error.

Examination of the recorded journal entries associated with the final practical assignment indicated that Subjects One, Two, Three, and Six all found the identification of errors and determination of the primary errors in performance easier following the development of an observation plan.

Subjects Four and Seven did not provide any evidence to suggest that the Diagnosis unit had been understood. Subject Four recorded that she felt confident identifying the errors in a performance but was unable to distinguish between the primary and secondary errors. Subject Seven provided no discussion whatsoever.

The determination of the primary errors in a performance is a difficult task and requires the integration of the entire skill analysis paradigm. It is the belief of the investigator that a greater number of examples and activities would have enhanced the participants grasp of this objective.

RESULTS OF THE SINGLE SUBJECT MULTIPLE BASELINE RESEARCH DESIGN

The results of the study are presented under the following subheadings: (a) level, (b) mean, (c) variability, and (d) trend. Graphic displays of the data are presented in Figures 16-22.

Level

The sequential application of the skill analysis paradigm to skills #1 and #2 resulted in consistent positive increases in the level of the percentage of correct responses for six of the seven subjects. The level increases were most evident on the identification of errors. Increases in the level of the percentage of correct responses on skill #2 and skill #3 were also associated with the application of the treatment to skill #1. No significant or consistent changes in the level were observed for skill #3 following the treatment to skill #2 (refer to figures 16-22)

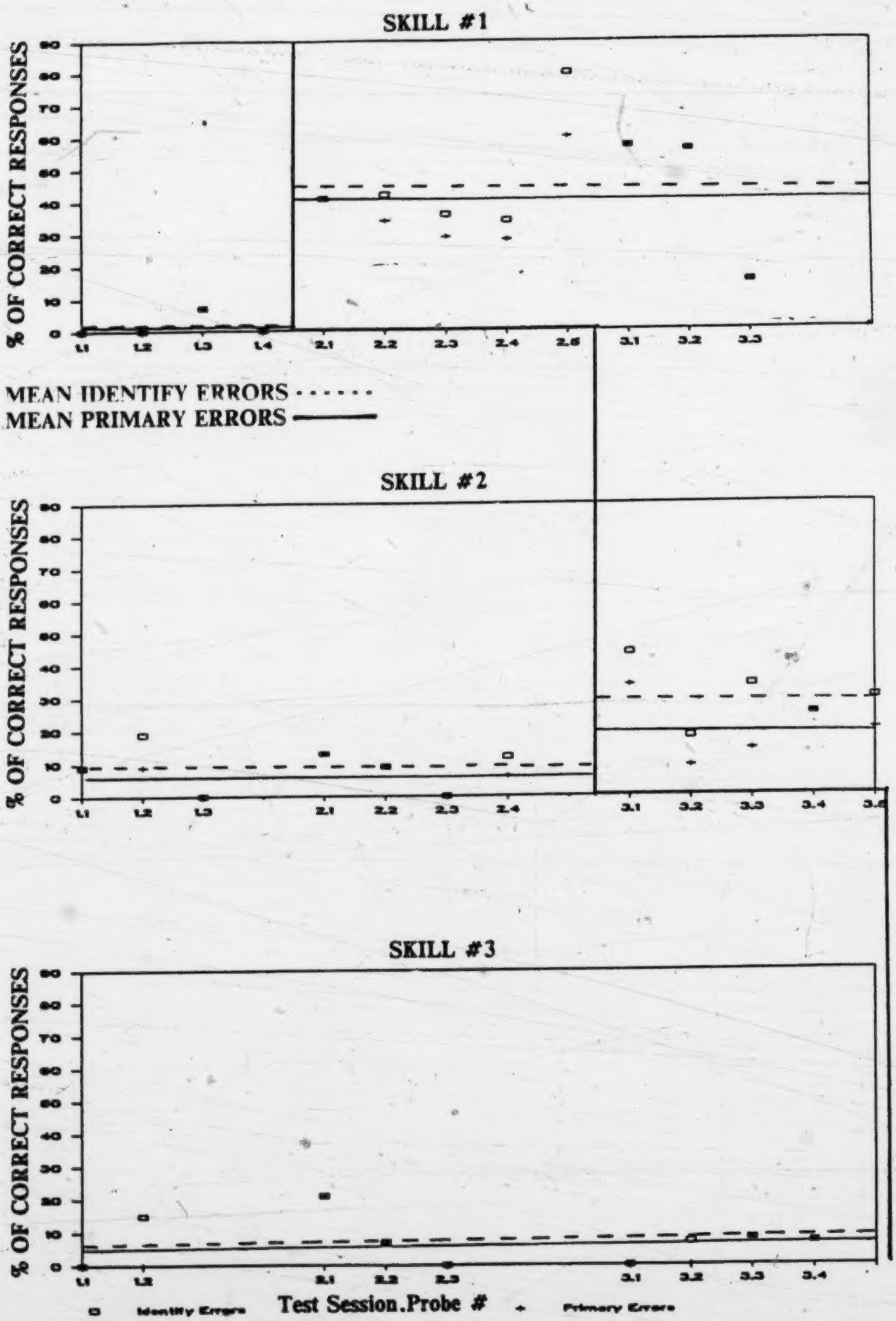


Figure 16. Subject One: Percentage of Correct Responses Across Tests and Skills

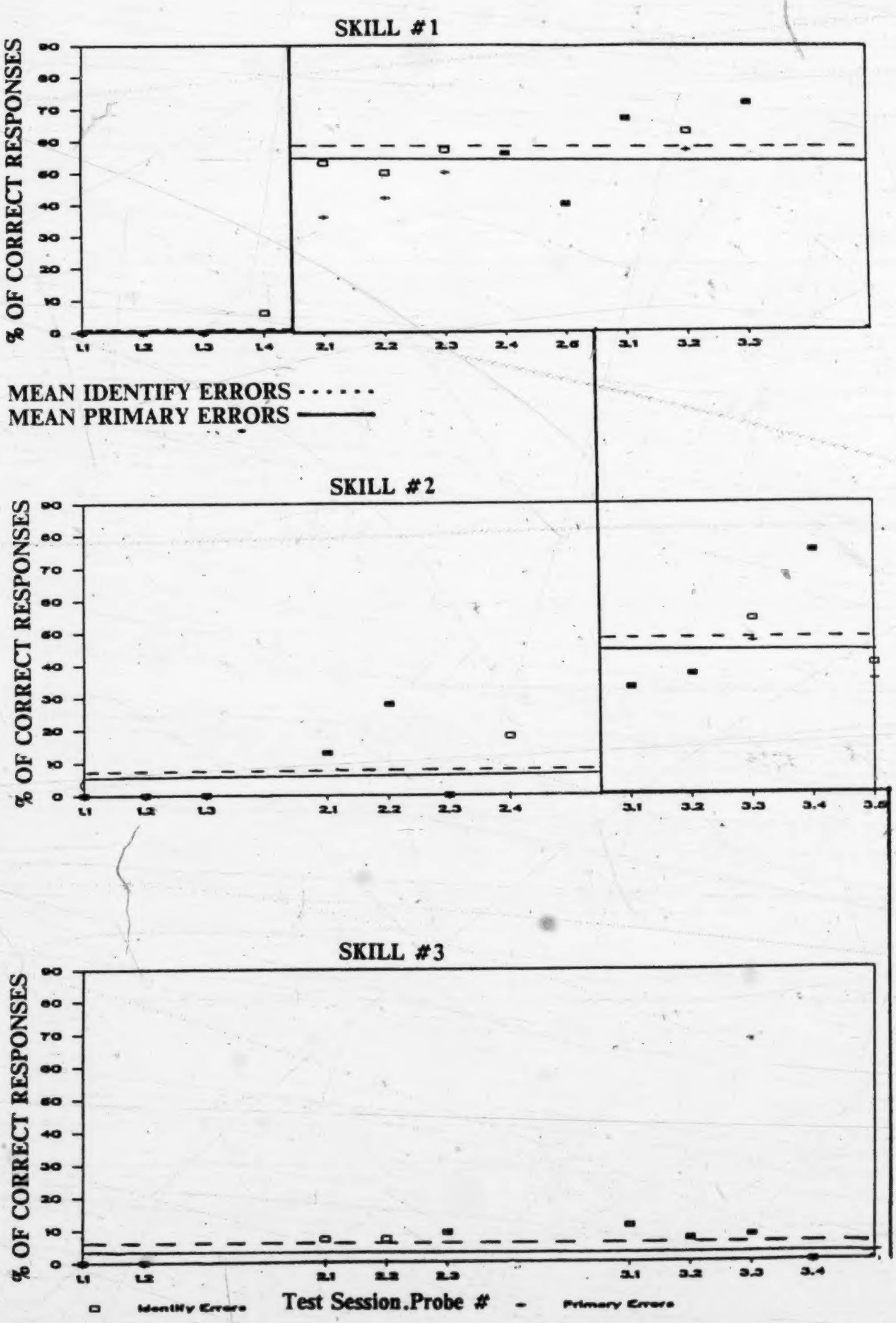


Figure 17. Subject Two: Percentage of Correct Responses Across Tests and Skills

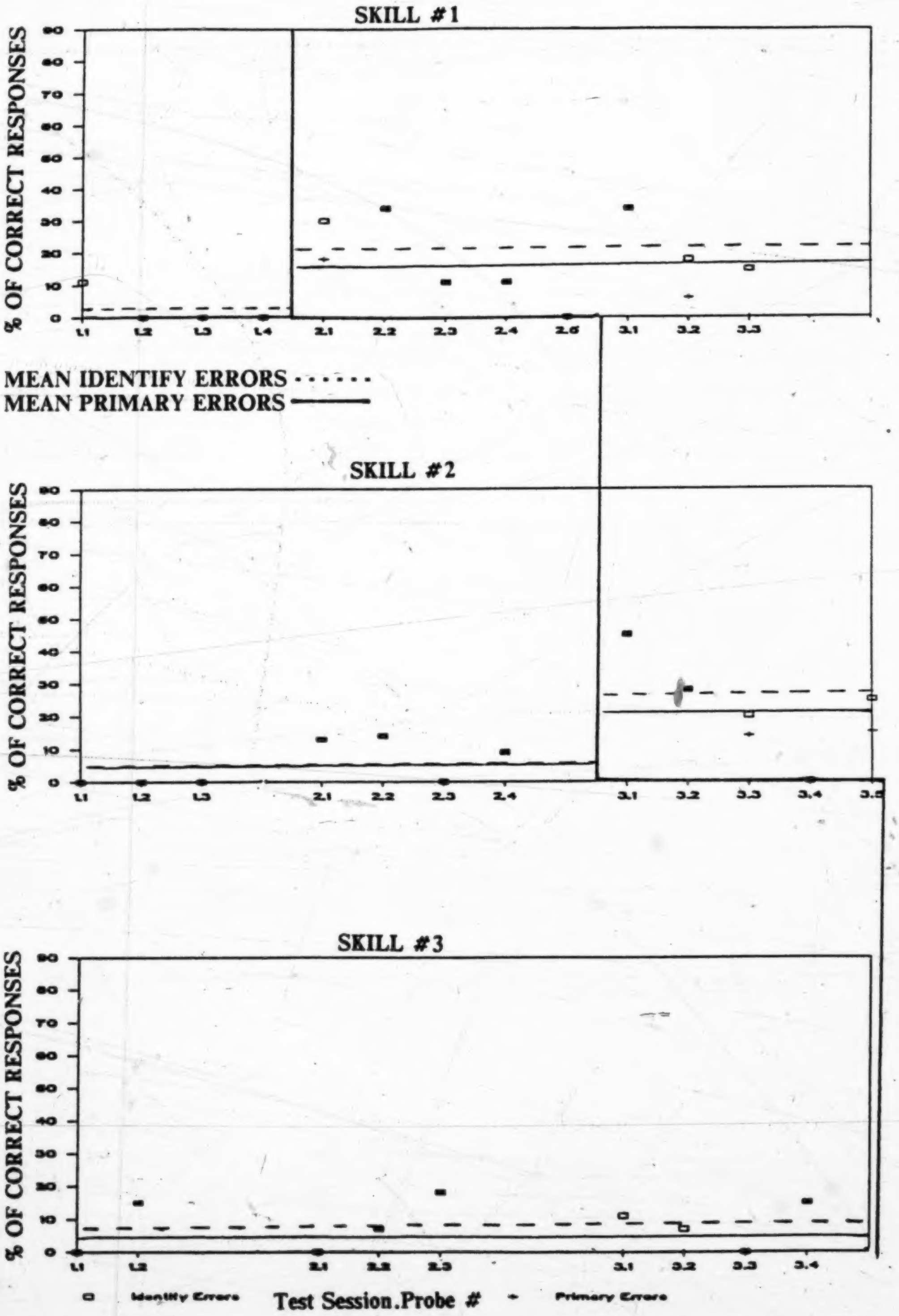


Figure 18. Subject Three: Percentage of Correct Responses Across Tests and Skills

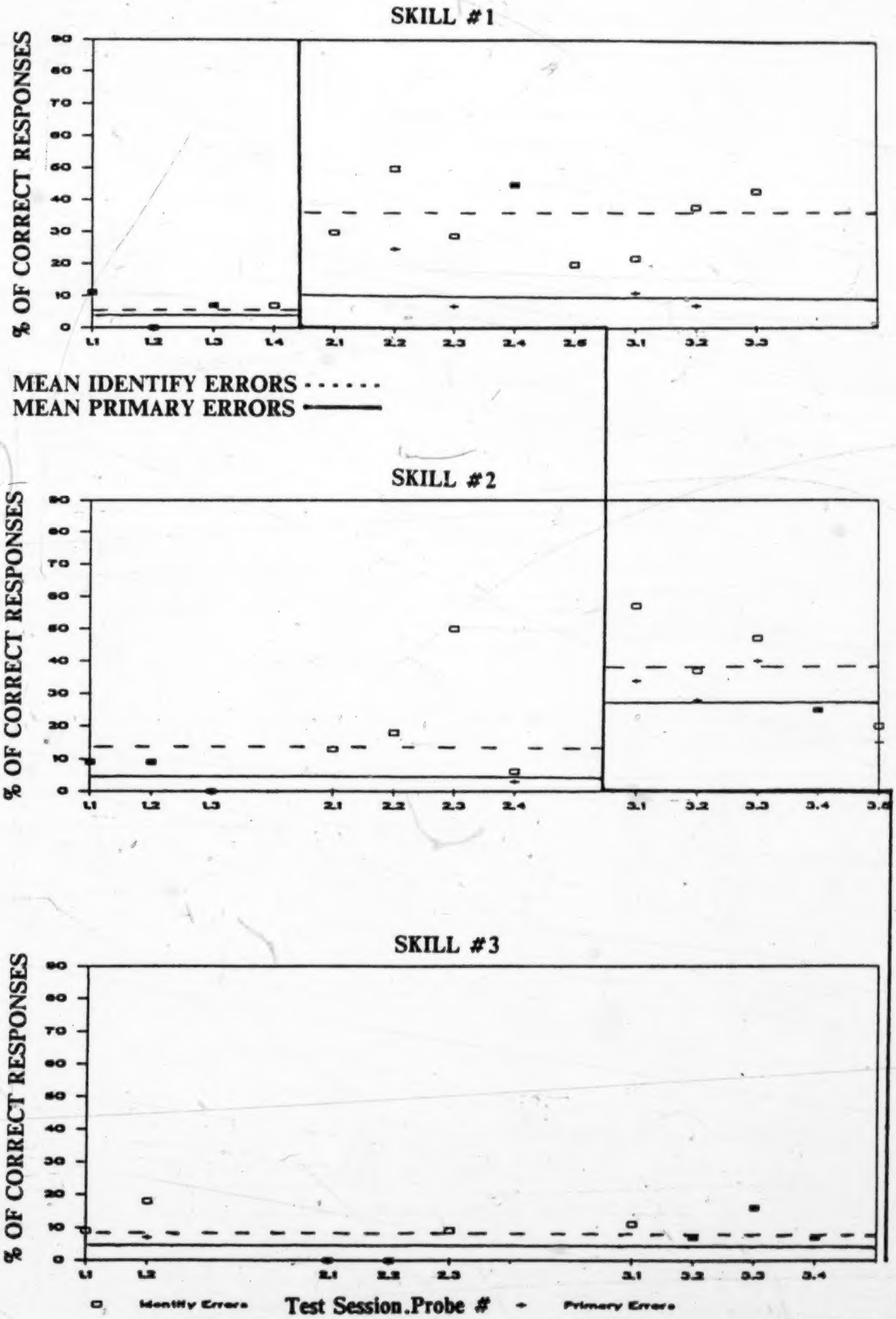


Figure 19. Subject Four: Percentage of Correct Responses Across Tests and Skills

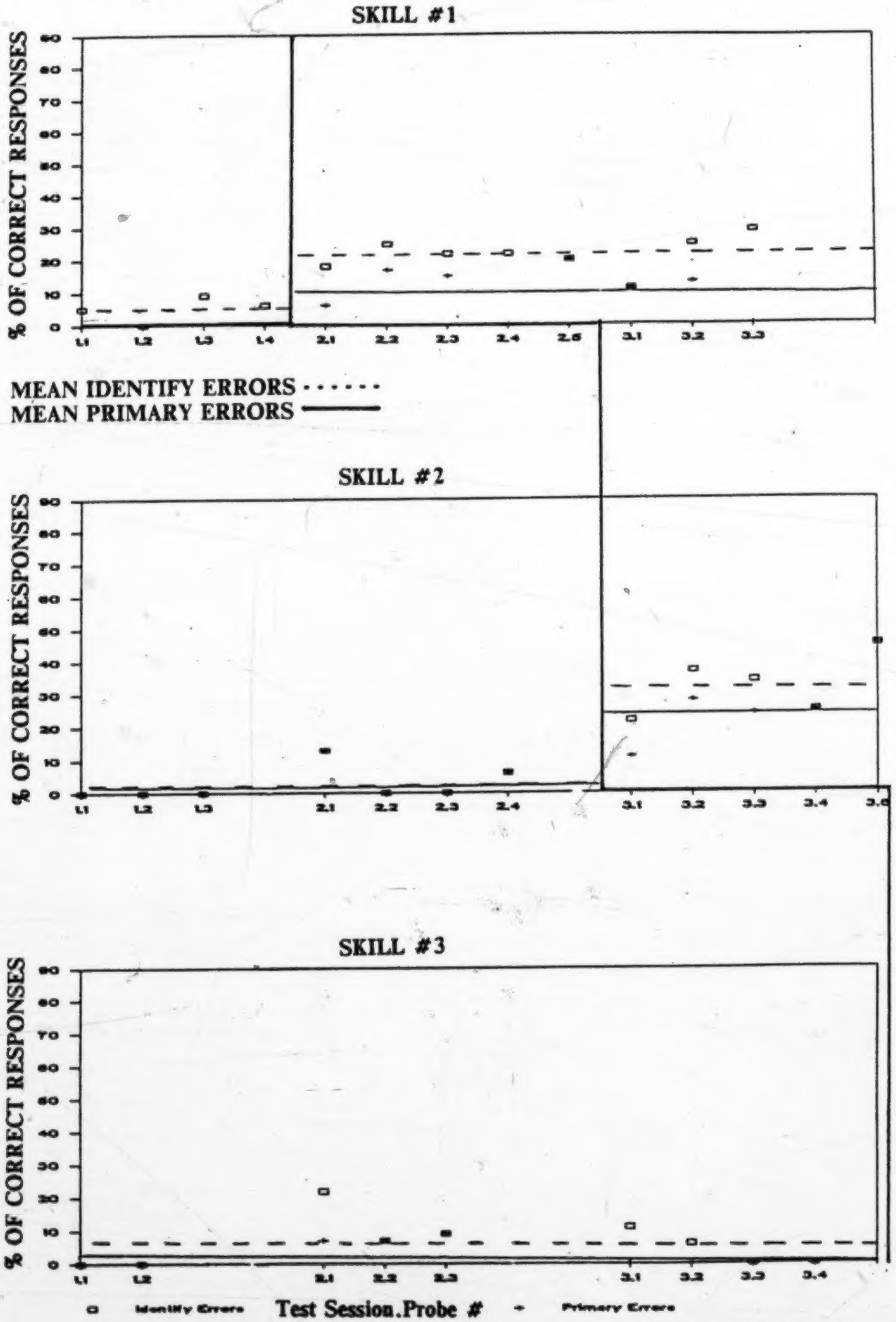


Figure 20. Subject Five: Percentage of Correct Responses Across Tests and Skills

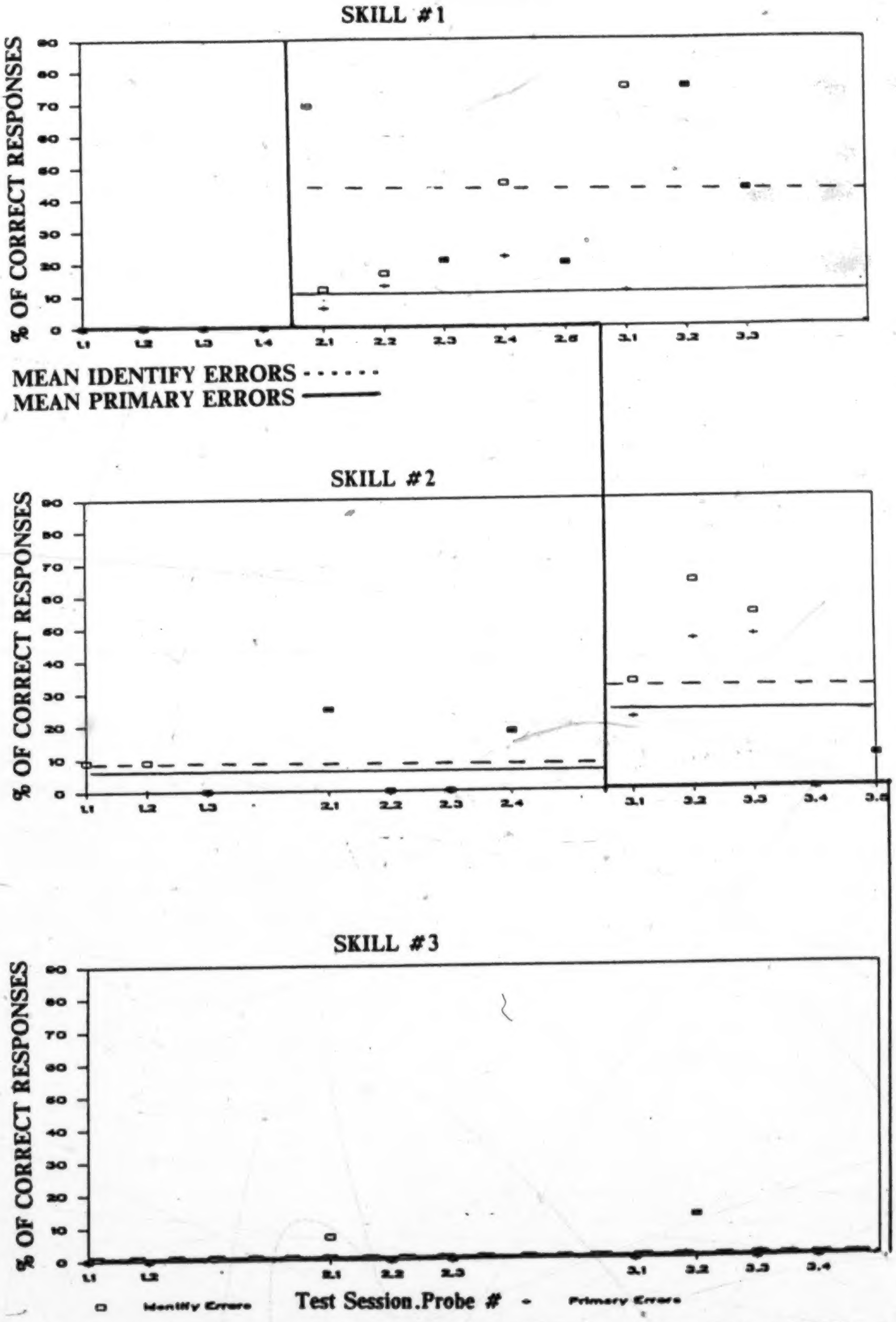
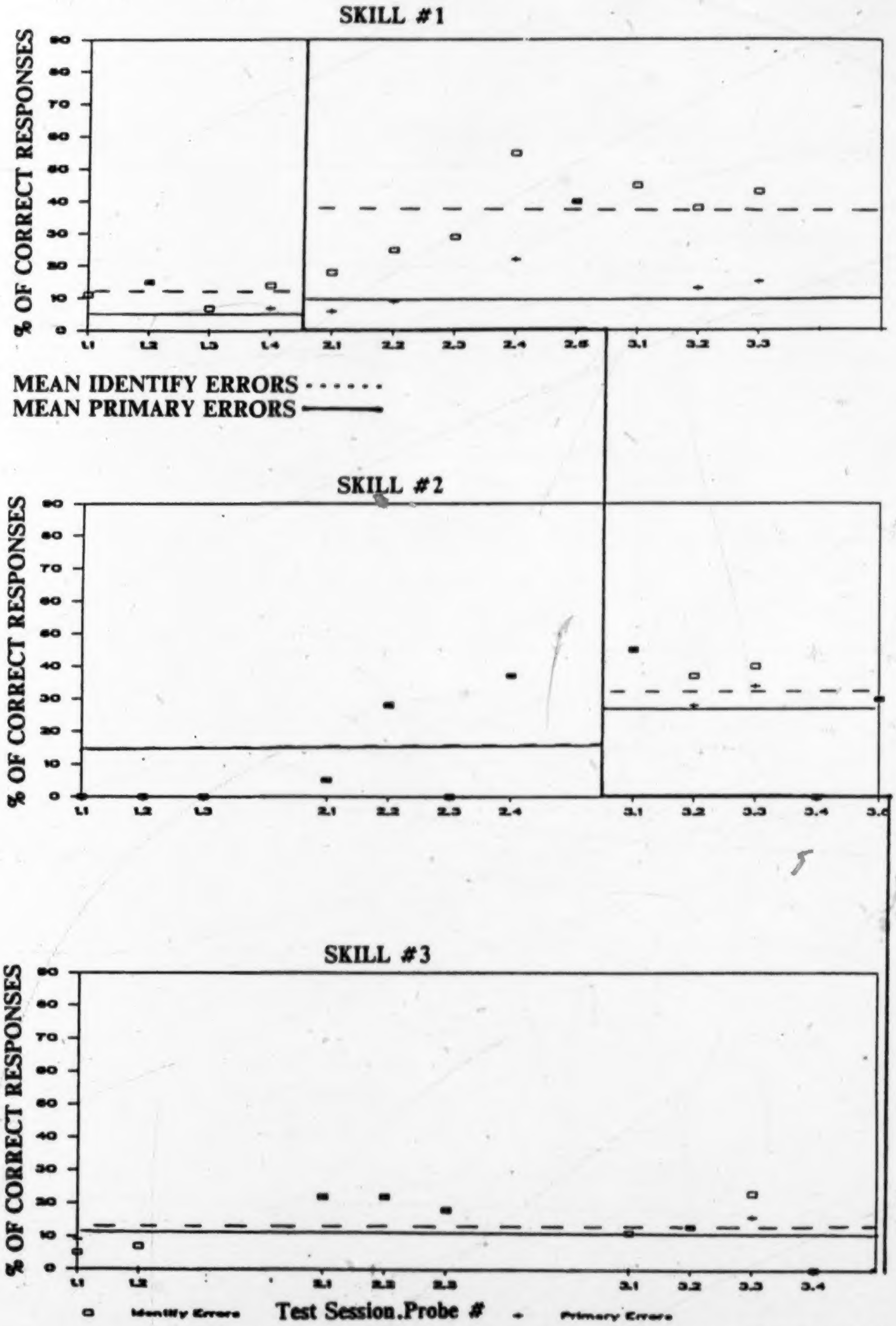


Figure 21. Subject Six: Percentage of Correct Responses Across Tests and Skills


SKILL #1

SKILL #2

SKILL #3

Figure 22. Subject Seven: Percentage of Correct Responses Across Tests and Skills

A positive change in level from the last probe measure of the baseline phase of Skill #1 to the first probe measure of the post-intervention period was demonstrated for all subjects for the identification of errors. This increased level ranged from a 4% to a 41% improvement. For all but two of the subjects the increase in level for the determination of primary errors showed a similar pattern but slightly less improvement. Subject Four demonstrated no change in the ability to determine primary errors. This finding was supported by her journal entries which stated an inability to discriminate between primary and secondary errors. Subject Seven decreased the level for the DP by 1%, however, this was followed by a similar slight increase in the subsequent probe measurements.

APPLICATION OF THE SKILL ANALYSIS PARADIGM TO SKILL #1: Following intervention on Skill #1 a positive change in level for Skill #2 was also observed for all of the subjects on both the IE and DP. The increase in level for five of these subjects was equal to 13%. Subject Six and Subject Seven displayed a 25% and 50% increase respectively. The instructional period on Skill #1 resulted in a slight increase (mean = 11%) in level for Subjects One, Two, Five, Six, Seven on their IE performance for Skill #3. With the exception of Subject Six each of these subjects also demonstrated a slight (mean = 10%) positive change on DP. Subject Three and Four decreased on both IE and DP following the intervention on Skill #1. A number of authors have suggested that generalized changes introduce ambiguity in the inference of a causal relationship (Cuvo, 1979; Kazdin, 1973; Kazdin, 1982; Kazdin & Kopel, 1975). The choice of design for this investigation was based on an a-priori assumption of independence among behaviors, or in this case among different sport skills. The results of a study completed by Kniffen (1985) found that the ability to identify critical features and to visually discriminate these features as correct or incorrect improved only following instruction on the specific skill. The review of the literature provided strong support for this assumption. The concommitant changes in the untreated variables may, therefore, have been due to a number of extraneous factors. Increased familiarity and decreased apprehension concerning the test procedures and objectives during the second testing session was highlighted in the subsequent review of the subject and investigator journals and is suggested as a possible confounding factor.

> I have always had trouble entering into areas which I have not researched alot and I find that I feel very uneasy when I am not prepared for something. I was not familiar with all the skills and found it very difficult to key in on the things which were errors of performance. I suppose you could say that I was distracted by various other things, ie. body proportions of the person (performer), the other class members sitting around me, the test atmosphere with the timings etc. I actually worked this session into something that it was not, and am embarrassed about it. (Subject One)

APPLICATION OF THE SKILL ANALYSIS PARADIGM TO SKILL #2: A positive increase in the change in level from baseline to the post-intervention condition for Skill #2 was demonstrated for all subjects on both IE and DP. Increases ranged from 8% to 51%. For four of these subjects the increase in the IE was greater than the increase in the DP. For all but Subject Six and Subject Seven the increase following the intervention on Skill #2 was greater than the increase immediately following the intervention on Skill #1, lending further support to the effects of the intervention. For six of the seven cases, the shift in levels (mean IE = 29%, mean DP = 23%) were greater than would be expected from ordinary fluctuations in performance.

Following the second intervention three of the subjects displayed a negligible (2%) increase in level on IE for Skill #3. Subject One and Subject Six displayed no change in level while a slight decrease in level was evidenced for Subject Three and Subject Seven. An increase in level for the DP was observed only for Subject Two. Subjects One, Four and Six remained constant while the level for Subjects Three, Five, and Seven decreased up to 18%. It is interesting to note that the instructional period on Skill #2 produced no clear or consistent positive changes in the level of any of the subjects' performances on Skill #1. If the covariance that was exhibited between skills following the intervention on Skill #1 had been due to interdependency of the skills, one would expect to have had these effects repeated following the intervention on Skill #2.

Confusing results were obtained for both Subject Six and Seven. The change in performance for Skill #2 was increased relatively more following the intervention on Skill #1 then following the intervention for Skill #2. Despite this confusing result the absolute level following intervention on Skill #2 was greater for both the subjects. The change in baseline level for Subject Six immediately following the intervention on Skill #1 can perhaps be attributed to the existence of an unexplained extreme value for that particular probe measure. However, this does not explain the results found for Subject Seven.

For four of the subjects the change in level in the post intervention period of both Skill #1 and #2 was temporary. The initial abrupt changes immediately following intervention for Subjects Three, Four, Six, and Seven subsequently faded. Kazdin (1982) stated that data reflecting changes of this nature suggest an initial treatment effect that is later counteracted by more powerful competing contingencies. With few exceptions in the post-intervention period for Skill #1, the decays in level occurred during the final probe measurements of the third testing session. Subjects completed these tests between 10:00 pm and 11:00pm on the last day of the term. The effects of fatigue and lack of motivation may well have intruded on their performances. This was reflected by the excerpts of two of the subjects.

> I found that I was grasping to find things that were wrong with the performance and was not observing as critically as I could be. My eyes were tired of focusing on certain spots and I then found myself actually seeing less. Perhaps I was becoming tired and not watching as well as I should be. (Subject One)
>
> There should be less demonstrations as after awhile I found it hard to concentrate. (Subject Three)

The above quotes support the suggestion that fatigue may have caused the fade in level following intervention. The results of this study do not, however, rule out the possibility that the negative change in level may have resulted from the inclusion of a weak treatment or that insufficient time was devoted to the application of the skill analysis paradigm.

Mean

The subjects average ability to identify errors and determine the primary errors in the video-taped performances was very poor during the baseline conditions for all three skills. All subjects demonstrated a marked increase (mean = 25%) in the mean from baseline to intervention conditions for both IE and DP for Skill #1 and Skill #2 (refer to Figures

16-22). The increase in means for both the skills was slightly greater for IE than for DP. Table 6 presents a comparison of the means for each phase, each subject, across skill.

Subject One and Two displayed a marked increase in the mean from baseline periods to the postintervention periods (greater than 30%). Subjects Three, Four, Six, and Seven also showed this distinct increase for the means for IE but displayed far lower means for the DP.

A marked increase (greater than 30%) in the mean values on both IE and DP following intervention on Skill #2 was observed for Subject Two. Subject Five also demonstrated a dramatic increase for IE but slightly less for DP. The mean values for the IE were greater than the mean values for the DP across all skills. It is interesting to note that Subjects One, Two, and Three had previously indicated in their journals that they understood the distinction between the primary and secondary errors. Of the seven subjects these three exhibited the least range in the mean percentages for the identification of errors and the determination of the primary errors.

A comparison of the baseline averages across the three skills illustrated that higher values were obtained for both Skill #2 and #3. The greater values may be attributed to the slight increase that was displayed during the baseline periods immediately following the intervention on Skill #1.

In several instances the means reflected more marked effects than were actually warranted. For example, the presence of extreme values in the data for Subject Six on the post-intervention period of Skill #1 significantly increased the mean value for that phase. Examination of the mean values during the post-intervention phase of Skill #2 for Subject Three, Five, and Seven indicated that the treatment had a significant effect on performance. However, further analysis revealed that an abrupt downward trend and subsequent overlap on the final data points limited the validity of the conclusions drawn regarding the significance of the means for these subjects. The mean values for Subjects Three and Four did not reflect the high variability exhibited during the post-intervention periods.

It is interesting to note that Subject Two displayed the greatest increase in the mean for Skill #1 following intervention and was the only subject with previous experience as an

Table 6. Mean Percentage of Correct Responses for Baseline and Post-Intervention Conditions Across Skills and Subjects

KEY
IE - Identify errors
DP - Determine primary errors
B - Baseline phase
PI - Post-Intervention phase
DIFFERENCE - Difference between the baseline mean percentage of correct responses and the post-intervention phase mean percentage of correct responses.

SUBJECT	SKILL # 1		SKILL # 1		SKILL #2		SKILL #2		SKILL #3	
	B		PI		B		PI		B	
	IE	DP	IE	DP	IE	DP	IE	DP	IE	DP
1	1.8	1.8	44.6	40.5	8.9	6.5	30.2	20.4	7.4	6.5
2	1.5	0.0	59.3	55.1	7.4	5.1	47.7	45.4	6.3	3.2
3	2.8	0.0	19.6	14.1	4.5	4.5	23.6	20.4	8.0	4.0
4	6.3	4.5	34.6	10.7	13.9	5.0	37.2	28.4	8.9	3.7
5	5.0	0.0	21.5	9.8	2.4	2.4	32.6	23.6	5.6	2.5
6	0.0	0.0	44.3	10.4	8.4	6.9	32.2	25.0	1.9	1.1
7	11.8	5.5	37.7	12.4	14.4	14.4	30.4	27.4	12.8	10.8
MEAN	4.1	1.7	37.2	24.6	8.5	6.4	33.4	27.2	7.3	4.6
DIFFERENCE		IE	DP			IE	DP			
		33.1	22.9			24.9	20.8			

observer or analyst of the vault.

Variability

In general, minimal variability (range less than 10%) was exhibited during the baseline phase for all three skills. A slight increase in the baseline variability for five of the subjects on Skill #2 was associated with the application of the skill analysis paradigm to Skill #1. Variability increased significantly during the postintervention period on skills #1 and #2.

The variability in the identification of errors and the determination of primary errors for the video-taped performances of Skill #1 during the baseline period was minimal. Subject Six actually displayed zero variability for both dependent measures while Subjects Two, Three, and Five displayed zero variability only on the ability to determine primary errors.

Data collected during the baseline phase of Skill #2 were somewhat less stable. Only Subjects One, Two, and Three exhibited minimal variability through out the baseline period for both IE and DP. Immediately following the intervention on Skill #1 the baseline measures for Subjects Three, Five, and Six demonstrated a slight increase in variation. The performance of Subject Seven displayed progressively larger fluctuations immediately following the intervention and sharply contrasted the minimal variability exhibited in the baseline data for Skill #1. The large regressions in the performance of Subject Seven suggested that extraneous factors operating through out the baseline period should have been identified and controlled. The inconsistencies in the results of Subject Seven may have been due to a state of extreme fatigue and stress that was displayed throughout the testing period.

Subject Four demonstrated a stable baseline for the determination of primary errors on Skill #2 but marked variability through out the baseline period for the identification of errors. Differences as high as 30% were observed between measures. Similar high leaps were exhibited in the data of several other subjects. Examination of the odd measures was undertaken to determine if there was any relation between the high scores and the number of performance errors on that particular probe measure. A subject who had by chance responded correctly to a measure which had an extremely low number of errors would have received an abnormally high score. There did not appear to be any consistent relationship between the number of performance errors and the extreme leaps. Only Subject Four demonstrated a leap during the baseline period on Skill #2 that may be explained by a probe measurement with a particularly low number of validated performance errors.

All subjects maintained a somewhat low and stable performance percentage during the baseline for Skill #3. This was particularly evidenced by Subjects One, Two, Three, and Six. Subjects Four and Seven displayed slight variability. The stable baseline displayed by Subject Five was disrupted by a 20% leap immediately following the intervention on Skill #1 and then returned to minimal variability. This leap corresponded to a similar leap in the baseline data for the same subject on Skill #2. Overall, the fluctuations displayed during the baseline period for Skill #3 were small in magnitude.

In general, far greater variability within the subject's performance on both the identification of errors and the determination of primary errors was observed following the instructional periods on each skill. Subject Two and Subject Seven displayed fairly stable positive progress immediately following intervention on Skill #2. Subject Five also demonstrated stable performance but with little increase in the actual performance percentage. Stable positive progess up to the fifth performance measure was observed for Subject Six. The graph then displayed fluctuations in both the IE and the DP for the remainder of the post-intervention phase. Subject Four and Subject Seven's performance was erratic throughout the post-intervention periods on Skill #1.

Following intervention on Skill #2, Subjects One, Two, and Four displayed relatively stable performances. However, of these three subjects only Subject Two demonstrated a positive progression. Greater variability in both the IE and the DP during the post-intervention phase of Skill #2 was evidenced by Subjects Three, Four, and Six.

Trend

The analysis of the change in trend following intervention on Skill #1 reflected a positive change in the direction and magnitude for three of the subjects. Two of the subjects displayed no change in the trend. Following intervention on Skill #2 only two of the subjects demonstrated a positive change in either the direction or magnitude of the trend. For the remaining subjects a zero or slightly positive trend during the baseline period was changed to a negative trend line following intervention.

Analysis of the tendency of the data to show systematic increases following intervention resulted in a number of unexpected findings (refer to Figures 23-29). Only Subjects Two, Six, and Seven demonstrated a positive directional change in the trend for the IE and DP from the baseline period on Skill #1 to the post-intervention period. Subjects One, Two, and Six demonstrated a change from a zero trend to a positive trend on DP.

Subject Three and Subject Five both went from a zero trend on DP during baseline to a negative trend following the intervention. For Subject Three the data were highly variable.

Both Subjects One and Four displayed very slight if any change in either the direction or slope of the trends. Subject Four displayed slightly negative trends in both phases on Skill #1. The trend for Subject One was very close to zero both before and after intervention. A mere continuation of the trend accompanied by a difference in the mean performance for pre and post-intervention periods would not be cause to conclude that the intervention had an effect (Schutz & Goodman, 1982). However, in each of these cases the continuation of the trends was accompanied by a significant increase in the level and the mean.

Inconsistencies in the trends following intervention on Skill #2 were as prominant as the increases in the variability exhibited following intervention. Only two of the subjects displayed a positive change in trend for IE and DP following the intervention on Skill #2. This change in trend was most dramatic for Subject Five who went from a zero baseline trend to a sharp positive trend following intervention. The trend for Subject One appeared to be effected very little by the intervention. In both phases the direction was negative with a slight slope.

A dramatic change in the direction of the trend lines was evidenced in the performance of Subjects Three, Six and Seven. Upward sloping lines during the baseline period were changed to downward sloping lines following the instructional phase. With the

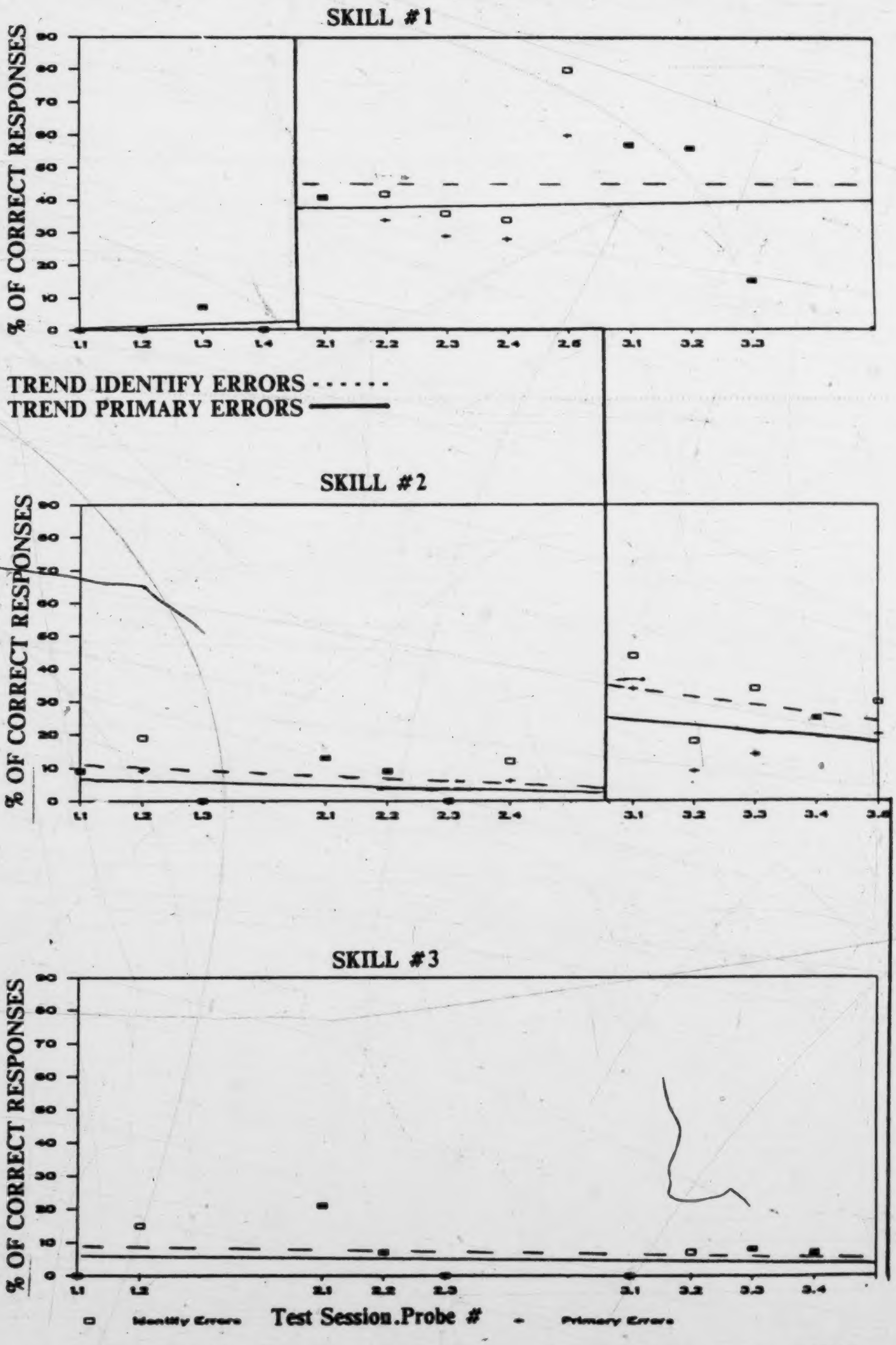


Figure 23. Subject One: Percentage of Correct Responses Across Tests and Skills

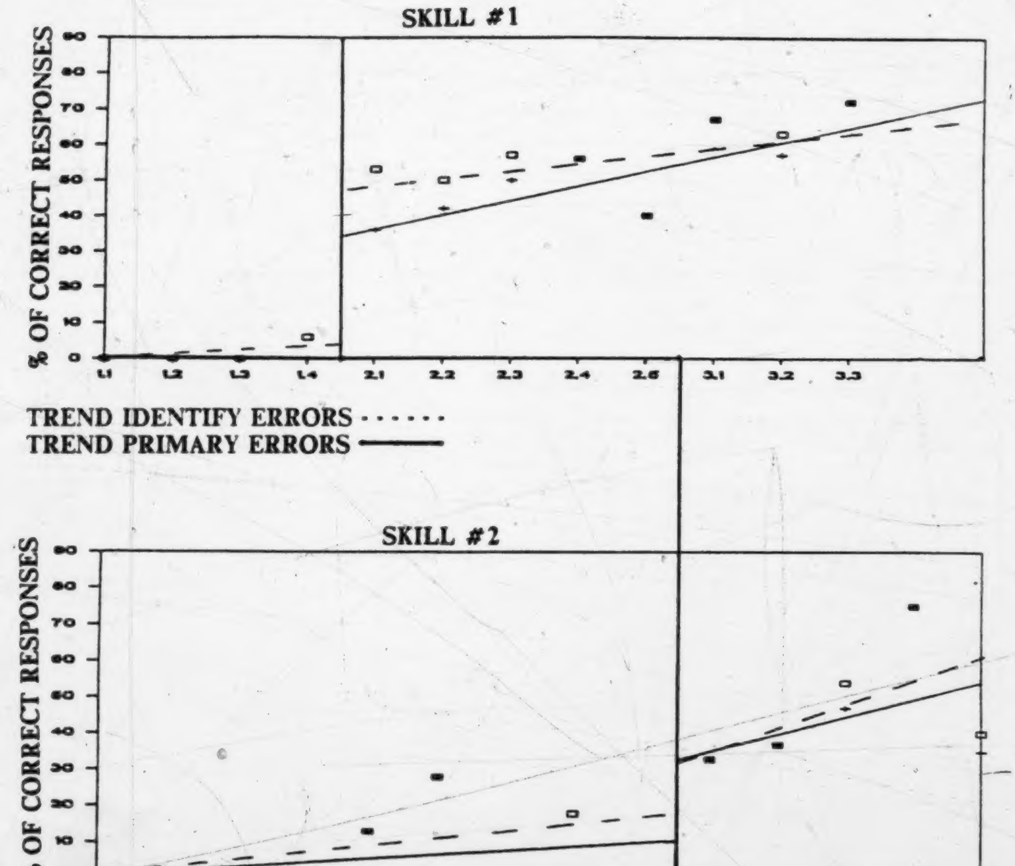
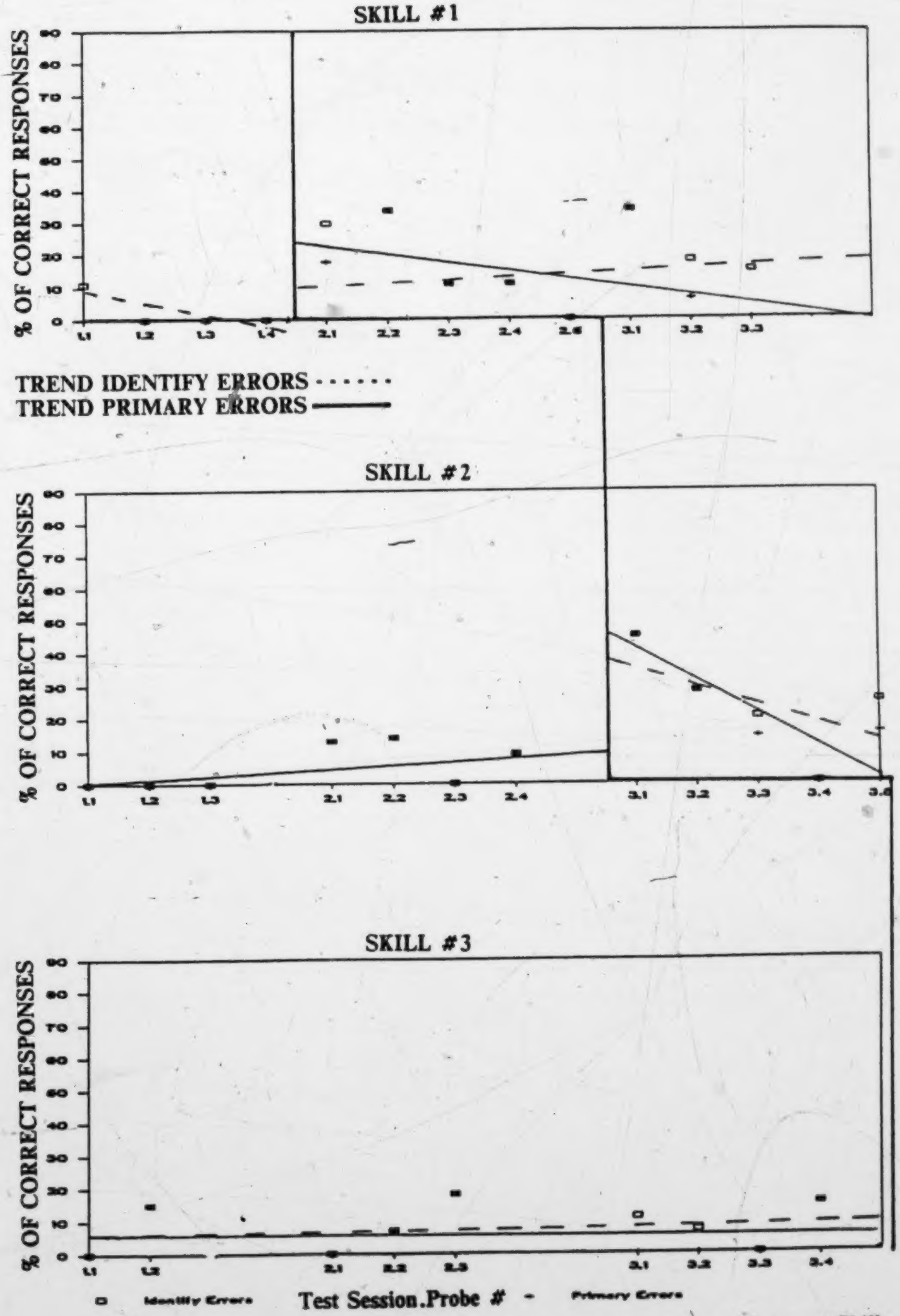


Figure 24. Subject Two: Percentage of Correct Responses Across Tests and Skills



SKILL #1

SKILL #2

SKILL #3

Figure 25. Subject Three: Percentage of Correct Responses Across Tests and Skills

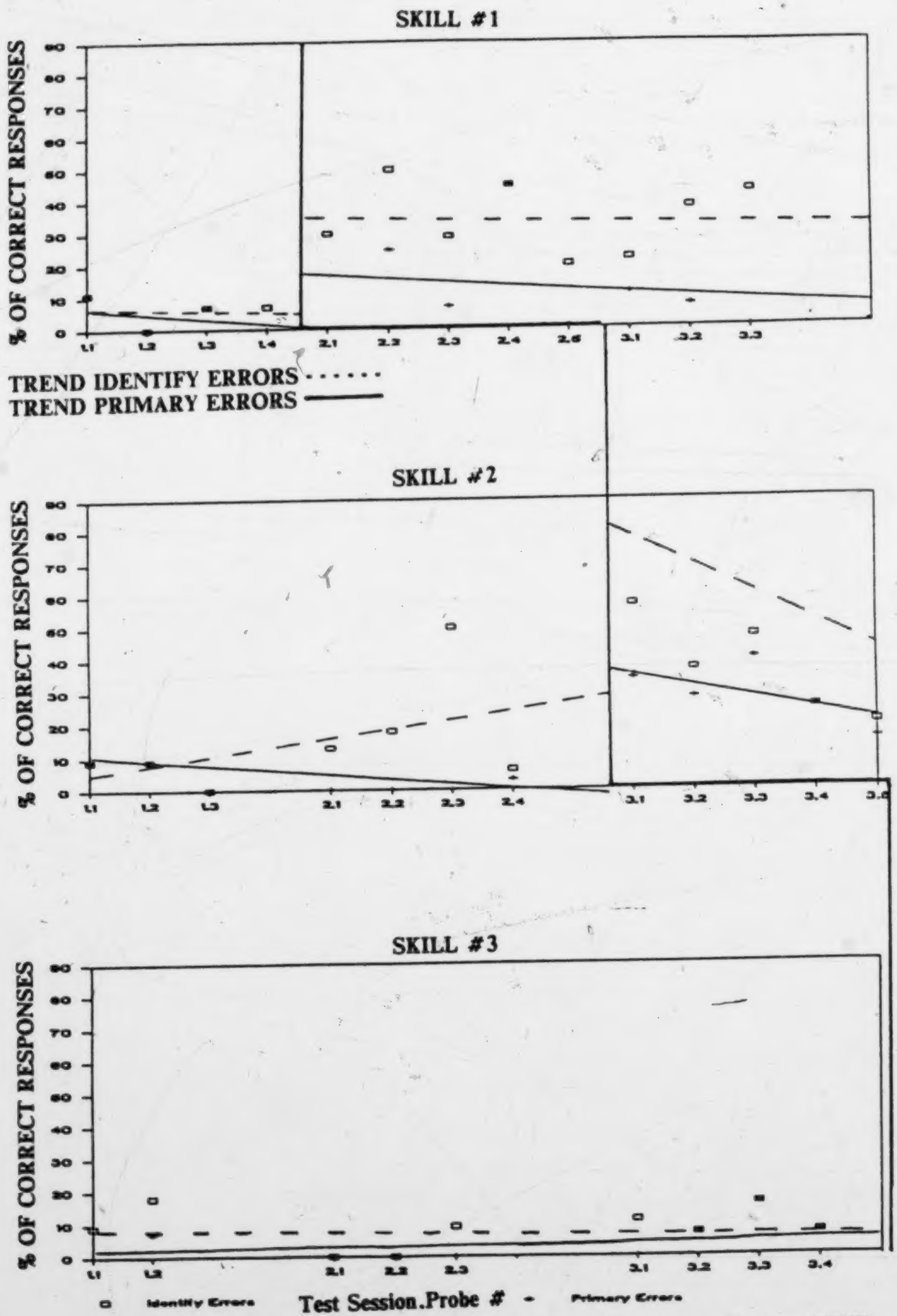


Figure 26. Subject Four: Percentage of Correct Responses Across Tests and Skills

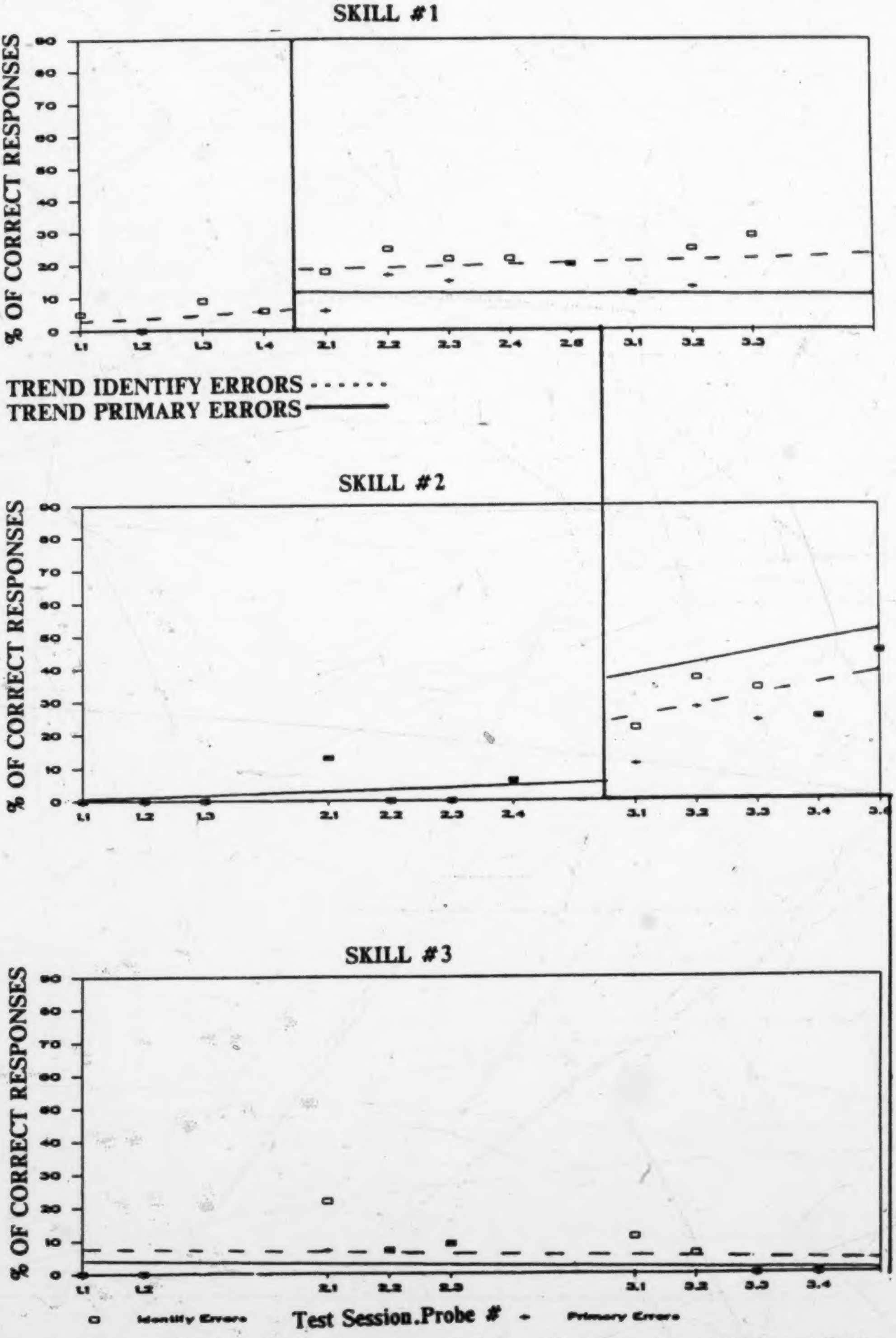


Figure 27. Subject Five: Percentage of Correct Responses Across Tests and Skills

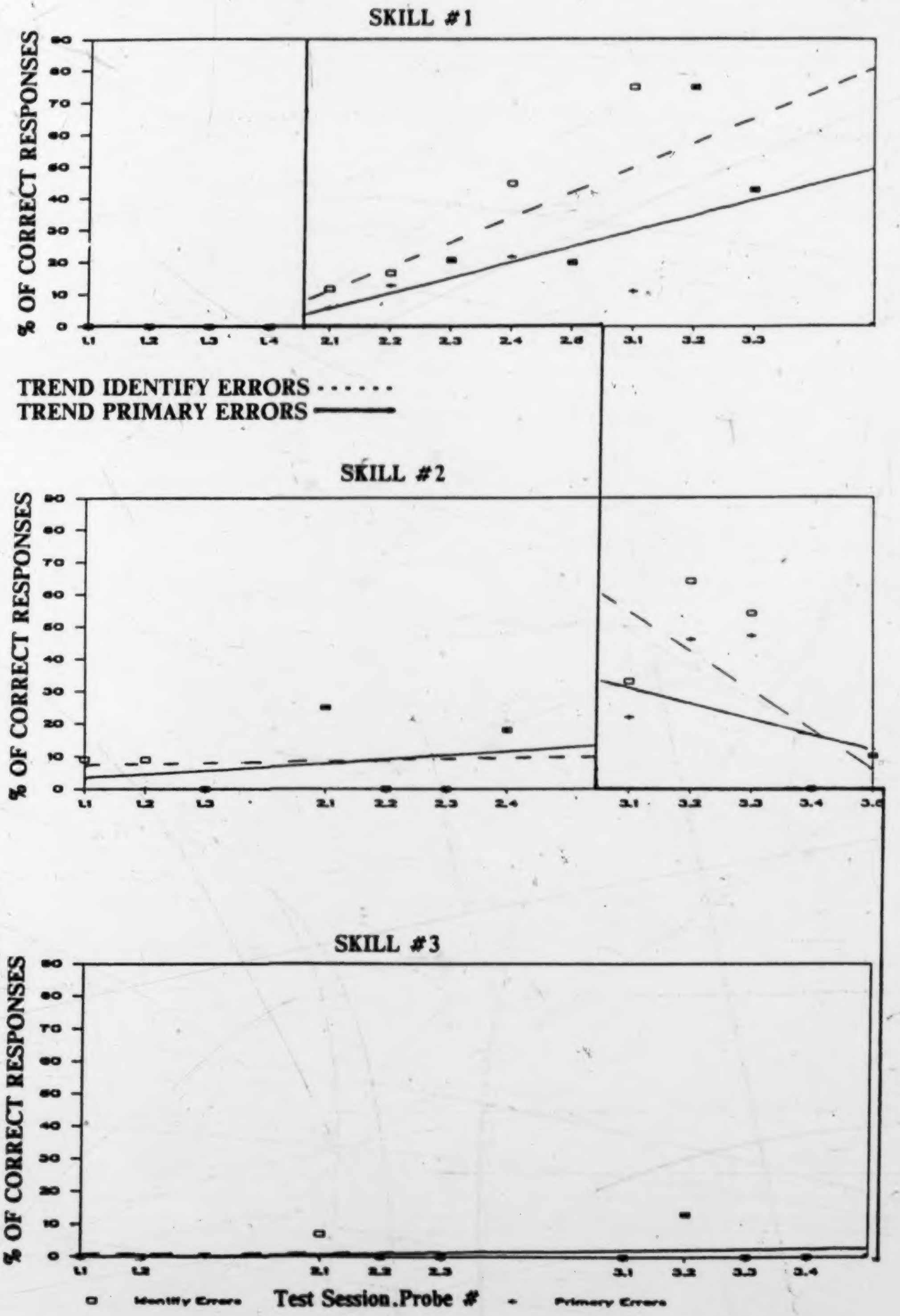


Figure 28. Subject Six: Percentage of Correct Responses Across Tests and Skills

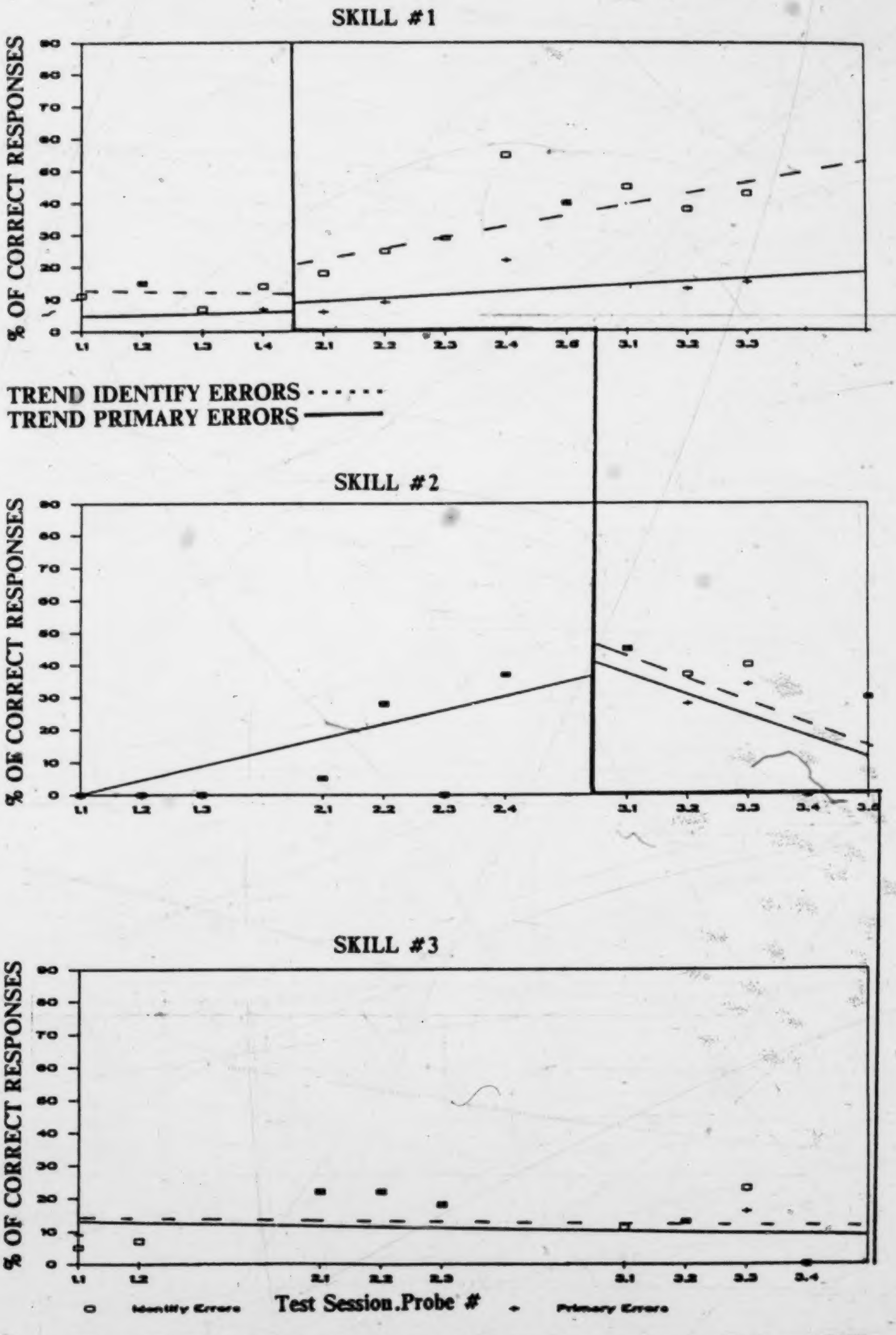


Figure 29. Subject Seven: Percentage of Correct Responses Across Tests and Skills

exception of Subject Seven the downward trends were also accompanied by high variability.

> Ambiquity of the changes across one or two of the baselines may not necessarily impede drawing an overall conclusion depending on the magnitude of the intervention effects .... (Kazdin, 1982, p. 265)

For all of the subjects who exhibited a negative trend following intervention the initial abrupt increase in level during the post-intervention phase decayed with time. Possible reasons for this finding were discussed in the section which focused on level and were attributed to the increased fatigue levels.

Very slight or no trend was observed for Subjects One, Two, Three, Five, and Seven for Skill #3. A positive trend was displayed by Subject Four and Six.

SUMMARY OF RESULTS

A summary of the results from the single subject research design is presented below.

1. Performances on both the identification of errors and the determination of the primary errors in the video-taped performances were initially very poor.
2. A positive change in level for the identification of errors was observed for all seven subjects.
3. A positive change in the level of primary errors identified was observed for five of the subjects following the intervention on Skill #1.
4. Intervention on Skill #1 was associated with changes in the levels displayed on other skills. There was a change in level for all seven subjects on Skill #2 and a slightly smaller change in the level for five of the subjects on Skill #3.
5. The generalized effects that were demonstrated following the first intervention were not repeated following the second intervention.
6. Intervention on Skill #2 resulted in a positive change in level for all seven subjects. For five of these subjects the change in level was greater than the change in level associated with the intervention on Skill #1
7. There were no consistent changes displayed on the level for Skill #3 following intervention on Skill #2.

8. All of the subjects demonstrated a positive change in the means for both IE and DP for both post-intervention phases.
9. In all cases, the mean values for the IE were higher than the mean values calculated for the DP.
10. Minimal variability was exhibited in the baseline data for all of the subjects on Skill #1.
11. The variability that was exhibited on Skill #1 increased for five of the subjects following intervention on Skill #1.
12. The variability that was displayed in the baseline data for Skill #2 increased slightly for five of the subjects following intervention on Skill #1.
13. The variability on Skill #2 increased for five of the subjects following intervention on Skill #2.
14. There did not appear to be any clear or consistent patterns of variability exhibited in the baseline data for Skill #3. Fluctuations were in most cases small.
15. The analysis of the change in trend following intervention on Skill #1 reflected a positive change for three of the subjects. Two of the subjects displayed slight to no change in the magnitude or direction of the trend. Two of the subjects displayed a negative change in trend.
16. Only two of the subjects displayed a positive change in trend following the intervention on Skill #2.

EXECUTION OF THE TREATMENT

An analysis of the journal entries, completed activites, and assignments provided the information necessary to verify the execution of the skill analysis training program and the application of the skill analysis paradigm during the final practical assignment. One of the subjects in the study submitted a journal which detailed the content and order of each component of each instructional unit. A comparison of the planned program outline to this journal confirmed that the skill analysis training program was implemented in full with negligible variations in the associated temporal factors. By contrast, the comparison did reveal that variations in the planned and actual implementation of the practical assignment existed. A summary of the deviations of these are presented in Table 7.

As a result of the PFT a total of nine hours was added to the training program in order to accommodate the addition of the practical assignment. Each three hour session was to be used to apply the skill analysis paradigm to the analysis of one of three novel skills. During the first of the practical sessions the investigator noted that components of the process took significantly more time than had been estimated and necessitated the extension of the first skill analysis training paradigm application to five hours. The remaining four hours were used to apply the skill analysis paradigm to the second novel skill. Therefore, a total of two skills as opposed to the intended three, were analyzed as part of the final practical assignment. Despite the additional time which was devoted to each task the investigator still felt there was insufficient time to thoroughly cover the pre-observation phase of the model. Subjects were requested to work in groups to determine the critical features for specific mechanical factors. To minimize the time that was devoted to the movement analysis phase each of the groups then pooled the critical features they had identified. Unfortunately, this produced a situation that did not emulate the realistic demands faced by the teacher and coach. The importance of training teachers and coaches to complete this phase of the skill analysis process unassisted must not be overshadowed. Furthermore, the practical assignment was intended to provide additional evidence that the subjects had learned how to identify the critical features for specific skills. Clearly, an understanding of the concept of critical features was exhibited and the subjects were collectively able to attain this objective. The results of this study do not, however, indicate unequivocally that the instructional unit was effective in training individuals to identify critical features.

COST

A detailed breakdown of the costs associated with the purchase and production of the visual and resource materials is presented in Table 8. The costs associated with the production and photo-copying of the numerous program handouts and overheads were not monitored.

Table 7. A Comparison of the Planned and Actual Final Practical Assignment

SESSION #	PLANNED PRACTICAL	ACTUAL PRACTICAL
Pre-session	Test Session #1	Completed Test Session #1
1	1. Apply the skill analysis paradigm to the analysis of skill #1 (2 hours) 2. Test session #2 (1 hour)	1. Applied the skill analysis paradigm to the of skill #1 (3 hours)
2	1. Apply the skill analysis paradigm to the analysis of skill #2 (2 hours) 2. Test session #3	1. Continued the application of the skill analysis paradigm to skill #1 (1 hour). 2, Completed test session #2 (1 hour) 3. Applied the paradigm to analysis of skill #2 (1 hour)
3	1. Apply the paradigm to the analysis of skill #3 (2 hours) 2. Test session #4(1 hour)	1. Continued application to skill #2 (2 hours). 2. Completed test session #3 (1 hour).

The equipment that was used in the development and implementation of the skill analysis training program was borrowed from various University departments and audio-visual labs.

The costs associated with the production of the test tapes used in the evaluation of the skill analysis paradigm have been separated from the training program costs and are presented in Table 9.

Table 8. Costs Associated with the Development and Production of the Skill Analysis Training Program

ITEM	COST ($)	PRODUCTION TIME (HOURS)
16mm Resource Film	40.00	6
Resource Video Tape	8.00	6
4 Blank Video Tapes	32.00	

Table 9. Costs Associated with the Development and Production of the Test Tapes

ITEM	COST ($)	PRODUCTION TIME (HOURS)
4 Video Test Tapes	32.00	10 (Approx.)

SUPPLEMENTAL LEARNING

The implementation of the skill analysis training program resulted in a number of outcomes not formally associated with the objectives of the program. Supplementary information was gathered through group discussions, informal investigator observations, and examination of the subjects' journals in order to enhance the discussion of the effects of the skill analysis training program. This information included subject reactions to the training program and the skill analysis paradigm, as well as any unintended learning effects.

Four of the subjects stated that they had found the introductory refresher course particularly helpful. Although each of the particpants had the required biomechanics prerequisites they admitted to having forgotten much of the theory and its application to the skill analysis process. Furthermore, these participants also felt that the review provided them with a common glossary of terms. Only one of the subjects stated that the amount of time spent on this section was unnecessary.

All of the participants in the program reacted positively to the instructional unit activities and the group video project. The activities and tasks were considered a vital component of the course and necessary for the understanding of the content. "It was through the activities that I felt progress in myself" (Subject Four).

A number of the subjects commented on the value of the social interactions that the activities stimulated. Subjects got to know one another which helped to create an extremely supportive class atmosphere. In addition, the interactions resulted in the sharing of many ideas and analysis experiences. One of the subjects commented on how much she enjoyed completing the journal. The recording of thoughts, reactions etc... provoked much reflection throughout the program. All of the subjects appreciated the extensive use of visual materials and the provision of resource materials. Subject Five suggested that the resource package could have been improved by the inclusion of filmed demonstrations of skilled performers executing the novel skills used in the practical assignment. This would have allowed the subject to study the skill from a visual perspective prior to attempting the identification of critical features. Subject Five also stated that he would have appreciated having all the course material prepared in a manual format. This would have enabled him to scan ahead to determine the future directions of the course.

Suggestions for improving the training program varied. Several of the subjects made recommendations which focused on specific activities included in the instructional units. Both Subject One and Subject Three stated that it was difficult to determine an acceptable response range for themselves as the performer. These subjects explained that when they considered themselves performing a skill they expected an ideal performance and therefore found it difficult to consider a range of response.

A number of participants presented suggestions on how to enhance the testing procedure used during the final practical assignment. Three of the subjects stated that the taped trials were too close together. Rather than have three instant replays they would have appreciated a short pause between each one. Three of the subjects also commented on the difficulty they had trying to observe the vault when they were not able to see the run-up phase of the skill. A greater field width would have captured the approach run.

An analysis of the subjects' reactions to the practical assignment provided some interesting insights into the effects of evaluating the implementation of the intervention. Initially, the investigator was concerned that the subjects were not provided with any feedback associated with their performance on each of the test sessions. Following the first test session all of the subjects expressed confusion as to the objectives of the procedure. They were unable to understand why they were faced with three skills with which they were completely unfamiliar. In addition, they were concerned with the level of performance that was expected of them.

The objectives of the practical sessions were to provide the participants with the opportunity to practice the application of the skill analysis paradigm to the analysis of novel skills, and to design a situation that allowed for the evaluation of the effects of the application of the intervention. From the recorded comments of several subjects it became apparent that the actual testing procedure served as a strong component of the overall training program intervention. The difficulty of the intial test evoked a number of reactions and consequently a number of insights.

> This session raised alot of reactions for me. I now realize why Moira made us look at the skills (lacrosse, vault, skating) without anything prepared (observation plan) or without any knowledge of the skill. She did this intentionally to exemplify the need of a recording form and an observation plan when trying to distinguish errors. (Subject Three)

> I left a bit dazed by how quickly we had to observe three performances of skills we knew nothing about. But maybe that is exactly what you were hoping for, since I did gain a greater appreciation for the work of the pre-observation. (Subject Four)

> Doing this exercise made me realize the fact that I must be prepared for the observation and have researched the skill and the reason for its being. (Subject One)

Although the testing procedure was initially perceived as a frustrating experience the subjects interpreted it as a powerful demonstration of how important the systematic approach to skill analysis was. Participants benefited not only from the additional practice and application of the skill analysis paradigm, but also from the internalization of the importance of the process involved in the acquisition of feedback information.

By far the most frequently discussed concern related to the scheduling of this course. As a result of trying to accomodate the timelines of eight people the course was conducted during the month of November. This was poor timing in the context of the university year. The last third of the term corresponded to the assignment of major papers and final exam preparation. Six of the subjects were carrying full course loads and were involved in a number of extra curricular activities. Subject Five was a full time teacher and was extremely busy with after school coaching programs. While subjects emphasized that the course requirements for the training program were fair, the addition of forty hours of course time during the last third of the term resulted in a difficult schedule for most of the participants. Informal observations made by the investigator added support to these comments. In general, motivation was high, however, the inconsistent performance that was demonstrated by some of the subjects during some of the sessions may be attributed to the effects of the schedule.

During the implementation of the PFT one of the subjects questioned how the consistency of the athletes' or students' performance was accounted for in the development of the observation plan. The question was raised again during the FFT and focused specifically on how the optimal number of observations were determined for the analysis of a performer who exhibited inconsistent movement patterns. Although the issue of performer consistency had been overlooked in the development of the instructional units the problem was accounted for in the development of the observation plan. Each observation plan is unique and is designed to address a specific purpose or task. If the purpose of the lesson is, for example, to improve the take-off technique of a jump then the number of observations needed to observe each of the relevant critical features should be selected regardless of the consistency of performer. The observer is attempting to optimize the actions of specific critical features during the take-off phase of the jump. Each time the critical feature does not fall within the acceptable response range a primary error is identifed, feedback is provided, and the skill is progressively refined. If inconsistent movement patterns are demonstrated then the purpose of the lesson needs to be redefined from improving take-off technique to decreasing the variability of the performance. The critical features and the number of observations should be re examined and selected accordingly.

The existence of many references to the universality of the skill analysis paradigm was particularly encouraging. Six of the subjects discussed how they would use the approach in their future coaching and teaching experiences. Three of the subjects had already attempted to apply components of the paradigm to their coaching.

> My understanding of the analysis process has changed dramatically. I realize this mostly beacause I've applied the model to several of my practices and I found that it has improved my feedback immensly. I now feel confident in knowing that I correct the key points of a skill (ie. primary errors). I also learned the importance of an observation plan as it eliminates alot of wasted time and allows me to focus on the right features. (Subject Three)

All of the subjects stated that their approach to skill analysis would change as a result of the training program. For most of the subjects these changes would center around the adoption of a systematic approach. Many of the remarks related to realizations of the importance of planning for observation.

None of the participants foresaw any difficulty applying the paradigm to the analysis of skills not covered in the course. One subject intended to use the approach to facilitate team try outs and suggested that the paradigm had applications for judges and officials as well.

> I wish that more people would adopt this methodology and then we could become

> universal in our methods .... eventually there could be some standardization of critical features and then every athlete would have the full benefit of coaching. (coaches would be knowledgable and would be keying in on the critical areas of performance). Wouldn't it be great to have a panel of judges that were really looking for the same things and had the proper principles of movement in mind - knew the critical features and their proper or acceptable range of response. (Subject One)

Different approaches to the process of skill analysis were presented and discussed in the review of literature. Past theorists have suggested the development of lists of common performance errors as a method of enhancing the skill analysis process. Norman (1975) highlighted the problems associated with attempts to analyze skill performance based only on a list of common performance errors. Comments made by a number of the participants prompted the idea of an alternative to the development of performance error lists. A far more useful tool would be the development of lists of common critical features. Subject One also stated that she would like to begin her own library of observation charts.

DISCUSSION OF THE RESEARCH QUESTIONS

1 Did the intervention evoke a positive change in skill analysis competency?

Although the data on all subjects showed varying degrees of level, mean, variability, and trend, there appeared to be some general patterns. The variability that was demonstrated during baseline baseline conditions across three skills was relatively low for all but one of the subjects. Variability was higher during post-intervention phases on the two skills for five of the subjects. However, the increase in variability following intervention was also accompanied by consistent and significant increases in several of the other criteria. With the exception of two subjects the abrupt changes in the level of performance for a given skill corresponded to the application of the skill analysis paradigm to that skill. Similarily, examination of the means across the different baseline and intervention conditions demonstrated consistent increases for both the IE and the DP following the application of the skill analysis paradigm.

By contrast the analysis of trend across baseline and post-intervention conditions did not exhibit any clear or consistent patterns. A negative trend in the performance percentage was demonstrated for a number of the subjects during the final testing session. Analysis of the subject and investigator journals suggested that this result may be due to an increased state of fatigue and a decreased motivation level.

Generalized changes following intervention on Skill #1 presented some ambiquity in the interpretation of the data. Close examination of the results following the second intervention indicated that the generalizations were not replicated. Several investigators (Cuvo, 1979; Kazdin, 1982) have stated that the concomitant changes in untreated behaviors may, in some instances, be attributed to the presence of extraneous factors. Based on a strong a-priori assumption of interdependence among the skills chosen for this study, alternative reasons for the generalizations were explored. The results of the subjective analyses of the journal entries provided evidence to suggest that the rise in the level of performance across skills immediately following the application of the skill analysis paradigm to Skill #1 was due to increased familiarity with the testing procedure indicating that testing effects did occur.

Further analysis of the changes in the level and mean for all subjects across Skills #1 and #2 indicated that the manipulation of the experimental variables had a much greater impact on the identification of errors than on the determination of the primary errors. The results of the subjective analyses suggested that the amount of time spent learning and practicing the target goal of the diagnosis stage may have been insufficient for the complexity of the task.

Based on the existence of minimal baseline variability and clear and consistent increases in the performance percentages for both the IE and the DP the intervention was concluded to have evoked a positive change in the skill analysis competency for the subjects in this study.

Information collected regarding the execution of the treatment provided evidence that the intervention procedures were carried out in full. Attributing the demonstration of any significant changes in skill analysis competency to the application of the intervention procedures was therefore justified.

2. Was packaged intervention a successful means of changing skill analysis competency?

The success of changing skill analysis competency through the application of the skill analysis paradigm was determined from the integration of the results of the data analyses and was based on consideration of both the experimental and therapeutic criterion.

Experimental Criterion : Visual analysis was regarded as a sufficiently rigorous method of determining the experimental criterion (Kazdin, 1982; Siedentop, 1981). Differences between the baseline and intervention phases were analyzed with respect to the mean, level, variability, and trends in the data. A conclusion regarding the evaluation of the relationship between a change in skill analysis competency and the intervention was drawn in the previous section. The packaged intervention was determined to influence a measure of control over the skill analysis competency of the subjects in this study.

Therapeutic Criterion: In order to determine whether or not the effects of the intervention were of applied significance the results were considered in view of their practical implications, the cost and time efficiency of the program and the immediate functional potential demonstrated by the skill analysis paradigm.

A number of investigators have suggested that the ultimate criterion for applied significance is whether or not the subjects considered their changes in behavior to be helpful in conducting successful learning experiences for their students and athletes (Dodds, 1979; Darst, 1976; McKenzie, 1981). Following the final practical assignment, five of the seven subjects recorded direct references to the benefits that they believed their students and athletes would receive as a result of the adoption of the skill analysis paradigm. These subjects felt that the application of the paradigm to the analysis of unfamiliar skills improved their ability to conceptually analyze, observe, and determine errors in performance technique. Although the other two subjects did not make any direct reference to the effects that the adoption of the skill analysis approach would have on their students, they praised the approach, stated that they intended to adopt it for their future analysis experiences, and felt they had improved as a result of it.

Conclusions were drawn regarding the cost efficiency of the skill analysis paradigm. The monetary demands associated with the application of the skill anlaysis paradigm were virtually nil. As in the development of a lesson plan the coach and teacher may need to visit a library, consult with experts, or perhaps sign out some visual materials. In any case, the costs would be minimal and were not considered to be a limitation to the practical implications of this approach.

A more relevant question is that of the time demands associated with the application of the paradigm. It was the belief of the investigator that initially the time and effort demands of the skill analysis approach would be perceived as great. As the observer became familiar with the process many of the steps would be internalized and decisions quickly made as to which aspects of the paradigm would need to be consciously addressed. "Once something is automated it is removed to a lower level operation and does not have to be consciously monitored all the time" (Lewis, 1980, p. 41).

As expected, all of the subjects noted that initially the development of the observation plan required a substantial amount of attention. However, with practice this stage of the process was perceived as a relatively simple one and the amount of time required to complete the plan was greatly reduced.

It must be noted that the time that was required to apply the skill analysis paradigm to the skills used in the final practical assignment far exceeded the time that had been originally estimated. The subjects indicated by their progress that a considerable amount of this extra time was devoted to the conceptual analysis of the movement. Only one of the subjects in the FFT stated that the amount of time required to identify the critical features would limit his application of the approach. While he stated that he would adopt the skill analysis paradigm for his coaching practices he did not intend to use it for his teaching preparation. On a similar theme one of the subjects in the PFT stated that she would not attempt to teach undergraduate education students how to use the model in their teaching practices as there was just not enough course time to get the approach across. A comparison of the time and effort demands of the skill analysis approach to the traditional approach of gaining skill analysis competency through extensive visual and analytic experience (maybe years) may have placed the issue in a different perspective. In any case, it was assumed that this individual did not feel it was crucial that student teachers learn to adopt this approach for their future teaching and coaching practices.

The investigator questions the philosophy on which these statements are based. The development of lesson plans to be used as a basis for instruction in the academic domain is considered critical. The initial development of these plans requires the conceptual analyses of the concepts, construction of learning and practice activities, and the development of presentation modes as well as feedback and assessment techniques. Teachers of academic subjects need no additional justification for the time and effort required for the initial development of these lesson plans. Does the instructor of movement technique not hold a similar degree of responsibility to his or her students?

Thomas(1982) stated that a successful field test should yield a user-ready intervention that will lend itself to wide adoption. Information derived from the final journal entries addressed the question of whether or not the intervention could be adopted under normal conditions and widely applied to the analysis of many different skills. All of the subjects responded that they were able to use the skill analysis training program and would have no difficulty applying it universally. Subjects based the functional potential of the skill analysis paradigm on the systematic and thorough approach to an area which had typically been perceived as confusing and frustrating.

Based on consideration of both the experimental and therapeutic criteria the application of the skill analysis paradigm was deemed to be an appropriate means of changing skill analysis competency.

3. Was the training program intervention a functional approach to training teachers and coaches how to analyze skills?

The results of the subjective analysis of the subject and investigator journals, as well as the degree to which the learner objectives were attained furnished information associated with the functional success of the training program.

A variety of tools were used to evaluate the learners attainment of the training program objectives. The results indicated that the training program was successful in founding the following analysis skills:

a. The identification of critical features.
b. The identification of factors which may alter the perceptual process.
c. The identification of factors which may have an effect on the performer.
d. The development of an observation plan and recording form.
e. The determination of an acceptable response range.
f. The adoption of observation strategies.
g. The identification of errors in a performance.

It is important to note that the results of this study did not, however, provide substantive evidence that the subjects were individually able to identify the critical features in a performance. Unfortunately, restrictions on the amount of available time precluded the assessment of individual achievement regarding the identification of critical features. Based on the fact that subjects were able to successfully complete all of the substeps which led to the identification of critical features, and were able to identify the critical features in a group situation, it is believed that provided with ample time they would be able to complete the task individually.

Although the results of the learner activities assigned during the Diagnosis and Remedation instructional unit indicated that the subjects were able to discriminate between primary and secondary errors there did not appear to be enough time to provide the extensive practice considered necessary. Several subjects expressed verbally an inability to determine the primary errors in a performance. The improvements in the level and mean for the DP following the application of the skill analysis paradigm were minimal for these same subjects. Prior to drawing conclusions regarding the effectiveness of the training program in the development of an ability to discriminate between the primary and secondary errors in performance, the Diagnosis phase should be evaluated following an increase in these practice components.

The results indicated that in general, the training program was unsuccessful in teaching the subjects how to select and use predictive features to furnish information about the critical features. The suitability of training inexperienced observers to use the concept of predictive features needs to be re-addressed.

The opinions and reactions that were expressed in the journals and in the informal discussions strongly supported the success of the training program. All of the subjects stated that the program was responsible for developing analysis skills. The subjects expressed a general concensus that the training program was necessary for anyone who was involved in the assessment of skill technique. This application ranged from inclusion into the undergraduate physical education curriculum to the development of inservice experiences for referees and judges of competitive sports.

The number of positive responses to both the PFT and the FFT clearly indicated that the skill analysis training program was successfully implemented in a realistic physical education and education undergraduate and graduate course setting. The skill analysis training program was implemented using a packaged intervention approach which included a set of objectives, target goals, mini-lectures, learning and practice activities, visual materials and resources, and was well suited to a course format. The total time that was allocated to the course implementation was approximately the same as that of a regular university course. A number of the participants also discussed the possibilty of implementing the training program as a sport specific inservice experience for teachers and coaches. Analysis of time necessary for the implementation of the training program suggested that the approach, in its present form, would not be feasible in a single workshop. However, the division of the training program into a series of weekend workshops or into an extended night course may be an appropriate alternative for a teacher and coach inservice training program.

4. What variables impacted on the training program intervention procedure?

Skill analysis competency was also influenced by other variables not included in the training program. Some of the most obvious influences were: the background and teaching style of the instructor, the subjects' attitudes, past teaching and coaching experiences, subject familiarity with the example skills, the effects of the evaluation procedures and fatigue, and time constraints.

The background and teaching style of the instructor was suspected to have had an impact on the success of the training program. Several participants from both the PFT and the FFT stated that the material could have been very confusing if the instructor had not been knowledgable and organized. In the final course summary Subject One wrote:

> I think however, that the person explaining the process must be fully aware of every minute facet of the model. I feel that our class was lucky in that we have learned the process first hand from the designer and thus had it (the skill analysis paradigm) layed out as it was intended. (Subject One)

Similarily, the participants frequently referred to the impact that the instructor's teaching style had on their change in skill analysis competency. The instructor incorporated a task oriented style with teacher directed and self paced activities. The establishment of an informal class atmosphere encouraged students to provide discussions of their experiences, ask questions, and discuss problems and concerns. This was considered key to the success of the program. Working through the difficulties as a group, as well as relating the approach to their own experiences helped the students to internalize the process. Methods by which future instructors of the skill analysis training program are certified will need to be carefully considered.

Examination of the results from both the PFT and the FFT indicated that the participants' previous teaching and coaching experiences had an influence on the impact of the training program. The influence varied from the amount of time that was spent on an activity to the components of the paradigm which were considered most relevant. In addition, each participant's contribution to the various discussions impacted on the other participants' understanding or appreciation of the concepts. In both instances the diversity of the participants enhanced the appreciation of the universality of the skill analysis approach.

Another confounding variable which influenced the training program intervention was the subjects' familiarity with the demonstration skills. The four demonstration skills were chosen as examples because they were common fundamental movement patterns and could be analyzed as closed skills. While it was reasonable to assume that all the participants would have had some experience observing and performing these skills, the degree of visual or kinesthetic experience with the skills was neither known nor controlled. The review of the literature indicated that there was no evidence to support the existence of a significant relationship between a performer's ability to execute the skill and analytic ability. However, Biscan & Hoffman (1976), determined that teachers and students who were familiar with a skill performed better on an analytic task than those who were not familiar with the skill.

The purpose of the movement analysis stage of the skill analysis paradigm is to systematically lead the teacher or coach through a conceptual analysis of the skill. It is quite likely that for those participants who were initially more familiar with the example skills, the movement analysis stage may have been perceived as easier to understand and apply. The extent to which this affected the results is difficult to ascertain. The role that skill familiarity plays in the learning of the skill analysis approach has implications for the development of sport specific skill analysis training programs.

The evaluation procedures that were incorporated in both the PFT and FFT were noted to have influenced the results of the intervention. During the PFT a series of tests were assigned which required the subjects to identify the critical features for a number of skills. Subjects were not provided with any information on critical features prior to the tests, nor did they receive any feedback following the tests. Subjects expressed extreme frustration at being repeatedly requested to identify these "mysterious things" called critical features. The investigator noted that although the procedure interfered with the presentation of the movement analysis instructional unit, was time consuming and perceived as a frustrating experience, the final presentation of the critical features had a marked impact on the participants. Subjects appeared very intent on learning exactly what these critical features were and whether or not they could identify them for the tested skills.

Similar effects were noted as a result of the testing procedures implemented during the final practical assignment for the FFT. Subjects were required on three occasions to identify errors and determine the primary errors for the video-taped performances of three skills. The immediate impact that these tests had on the participants' appreciation of the importance of the conceptual analysis and the development of an observation plan and recording form was discussed in the preceeding chapter. It is quite possible that the testing procedures also effected a long term appreciation of the practices and concepts implicit in the Diagnosis phase.

The attitude of the subjects involved in both the PFT and the FFT most certainly influenced the intervention. With the exception of one of the subjects in the FFT and one of the subjects in the PFT, all of the students were extremely enthusiastic about the training program and the opportunity to improve their skill analysis competency levels. The participants in the FFT further demonstrated their interest by enrolling in a course which added a considerable load to their fall schedules. The obvious enthusiasm greatly enhanced both the teaching and learning process. The results may well have been different had the training program been implemented as a compulsory course offered during regular hours.

While 13 of the 15 subjects who were led through the two skill analysis programs demonstrated a consistent commitment to improving their analysis skills, Subject Seven from the PFT was restrained, appeared unmotivated, and stated on a number of occasions that she was experiencing excessively heavy demands from other courses. She appeared to make no attempt to assimilate or integrate the ideas that were presented during the instructional units. Analysis of the journal for this particular subject provided little insight into the effects of the training program.

Subject Four demonstrated a degree of resistance to the learning of a new approach to skill analysis during the PFT. Analysis of the recorded journal entries and informal observations suggested that Subject Four's attitude may have been a result of her previous experiences using Laban Analysis techniques. This particular subject had an extensive dance background and during initial sessions frequently made analogies to the ways in which Laban analysis was used to address the concepts which were being discussed. The realization that the focus of the skill analysis paradigm was on technique and did not consider the temporal and spatial components of dance, as defined by Laban, appeared to cause some confusion. It is difficult to postulate on the representativenes of Subject Four's view to other individuals with a dance background.

Other variables which are thought to have impacted on the intervention procedure were participant fatigue and subject interaction. The results of this study do not provide any information on the nature or extent of these effects.

In conclusion, the skill analysis training program was implemented using a packaged intervention format. A number of variables were recognized to have exerted a measure of influence on the results of this investigation. Due to these extraneous factors the results of the study may only be expected to generalize to a group of similar subjects in a similar setting, and under similar conditions.

5. What are the difficulties, constraints etc.. of preparing physical education students, coaches, and teachers to analyze the performances of gross motor skills?

This study revealed that changing teacher and coach skill analysis competency is a complicated process. Although the subjects all met the basic pre-requisite training, increases in skill analysis competency varied greatly. Variables other than those included in the training program impacted on the results and have been discussed.

A number of investigators have supported an approach to qualitative analysis which is based on the identification of the relevant biomechanical constructs (Hay &

Reid, 1982; Hensley, 1983; Norman, 1975). The results of the FFT suggested that, in general, the subjects did not appear to find the identification of the biomechanical constructs to be a difficult task. This is believed to be due to the fact that all of the students had completed a number of courses which dealt with basic mechanics. In contrast, the subjects who participated in the PFT did not have as strong a background in biomechanics. Many of the particpants had only completed one biomechanics related course and for many of them it had been completed over six years ago. These subjects expressed much more concern over their ability to complete the movement analysis process without direct guidance. The refresher session at the beginning of the program served to provide the participants with a common set of definitions and a review of the basic principles and concepts. Without this review it was unlikely that the subjects in the PFT could have completed the movement analysis phase of the paradigm.

As stated initially the content of the refresher sessions was based on the NCCP Theory: Skill Analysis chapters. It was not one of the objectives of this study to evaluate the effects of the biomechanics review or to formulate hypotheses regarding the degree of theoretical competency required. Certainly, the results of this study do suggest that some degree of theoretical backgound is necessary. However, whether or not a greater knowledge of biomechanics would improve teachers' and coaches' ability to analyze performances of gross motor skills needs to be investigated.

Training Physical Educators and coaches to analyze the performances of gross motor skill appears to require a considerable amount of instruction and practice time. The results of this study suggested that 37 hours were required to lead the participants in succession through the skill analysis process and accomodate the learning and practice activities of the program. A weekend workshop was not viewed as a possible format possibility and may therefore limit the ease of program implementation. Recognition of the degree of commitment that is neccessary to improve teacher/coach analysis competency must preclude the widespread application of the program.

Subjects in both the PFT and the FFT experienced the benefits of a low student/teacher ratio. Students received ongoing individual and group feedback, and were provided with the opportunity to express and discuss their many opinions and reactions. Following each activity the class discussed the various small group responses. In addition, the feasibility of implementing the video project was greatly enhanced by the relatively small number of participants involved. The foregoing factors were considered key to the success of the training program. The student/teacher ratio would certainly affect the successful integration of theoretical and practical aspects of the skill analysis paradigm in future implementations.

Chapter IX

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The primary objectives of this research project were to develop, implement, and evaluate a training program designed to promote skill analysis competency. More specifically, a holistic approach was examined in detail in an attempt to unify, organize, and integrate the analysis process, and to provide teachers and coaches with an effective alternative to the identification of technique errors.

Skill analysis viewed as a totality was determined to consist of four major phases: (a) pre-observation, (b) observation, (c) diagnosis, and (d) remediation. There was strong support in the literature for a pre-observation phase which focused first on the identification of critical features which are systematically determined through a conceptual movement analysis. A second part of the pre-observation phase was identified and determined to involve the formation of an observation plan and recording instrument. In order to effectively construct a specific observation plan the preliminary consideration of constraints on the perceptual process and the performer was deemed necessary. In preparation for the diagnosis phase the determination of an acceptable response range was also included. During the observation phase, the observer receives visual sensory input which must be appropriately monitored, filtered, and recorded. Based on the Clinical Diagnosis Model presented by Hoffman (1982), the diagnosis phase of the paradigm was initiated by the recognition of a discrepancy between the observed response and the desired response. The phase involves the identification of errors in a performance followed by discrimination between primary and secondary errors. Remediation of the primary errors was concluded to be the final phase of the skill analysis paradigm.

A training program was developed based on the skill analysis paradigm. Associated with each of the phases was an instructional unit consisting of target goals, instructions, learning and practice activities, feedback, visual materials, resources, and assessment. The intervention package was subsequently implemented as a course entitled ***Strategies for the Observation and Analysis of Motor Skills***.

The results of the study were based on the information derived from fifteen course participants with a strong physical education background, teaching and coaching experience, and an interest in the skill analysis process. Data were obtained primarily from daily and summary journal entries, informal discussions and observations, and the completion of a number of class and group activites. In addition, a single subject multiple baseline research design with probes was used to test each subject's ability to identify errors and determine the primary errors from the video-taped performances of three skills.

The adoption of a multi-faceted approach resulted in a thorough summative evaluation of the skill analysis paradigm and training program, as well as the provision of information regarding improvements in the participants' skill analysis competency.

FINDINGS

The findings of the investigation are presented in six sections: (a) initial status, (b) performance following a period of instruction, (c) skill analysis competency, (d) execution of the treatment, (e) cost analysis, and (f) supplemental information.

INITIAL STATUS

Analyses of the subjects' experiences, background, and initial theoretical status indicated the following:

1. All of the subjects had extensive involvement as sport participants, coaches and physical educators.
2. All of the subjects had been previously exposed to courses which were related to the area of biomechanics and skill analysis.
3. Six of the seven subjects acheived a score of 60% or better on a test which was designed to provide a measure of theoretical competency.

PERFORMANCE FOLLOWING A PERIOD OF INSTRUCTION

Evaluation of the learners' acheivement of the specific program objectives resulted in the following findings:

1. All of the subjects were able to complete the steps involved in the identification of critical features. In addition, critical features were successfully identifed during small group and class activities.
2. The instructional unit which focused on direct and indirect constraints on the observation process resulted in the subjects' consideration of the factors which alter the perceptual process and other relevant correlates.
3. The instructional unit which focused on the development of an observation plan was unsuccessful in training the subjects how to use and select predictive features to furnish information about the critical features in a performance.
4. All of the subjects were able to develop and subsequently adopt an observation plan and recording form.
5. The instructional unit which focused on the determination of an acceptable response range appeared to be successful in providing the subjects with the rationale and procedure for the development of a mental image. In addition, the practice components resulted in the subjects' assimilation of the relevant information and subsequent determination of an acceptable response range.
6. As a result of training on the diagnostic phase of the skill analysis process subjects were able to identify errors in performances that were deemed to be the result of poor technique. The instructional unit was unsuccessful in training all of the subjects how to discriminate between the primary and secondary errors in a performance.

SKILL ANALYSIS COMPETENCY

A single subject multiple baseline research design was used to evaluate the relationship between the application of the skill analysis paradigm and a change in skill analysis competency. The results were:

1. The ability to identify errors and discriminate between primary and secondary errors in the video-taped performances of three skills was very poor for all subjects under baseline conditions.
2. The subjects' performance percentages were significantly improved following the application of the skill analysis paradigm to each of the skills.
3. Following intervention, the subjects' ability to identify errors in the performances improved somewhat more than did their ability to determine the primary errors in the performances.
4. Initial improvements that were observed in the performance percentages following the application of the skill analysis paradigm displayed a gradual decay for 50% of the cases, and was attributed to other competing contingencies.
5. All of the subjects were satisfied with the structure and content of the skill analysis paradigm and felt that the intervention had significantly enhanced their skill analysis competency.

EXECUTION OF THE TREATMENT

1. Information collected regarding the execution of the treatment provided evidence that the training program intervention procedures were carried out in full.
2. A comparison between the planned and actual final intervention procedure indicated that one of the four parts of the practical assignment was not implemented. Time restrictions precluded the application of the skill analysis paradigm to the third novel skill.

COST ANALYSIS

1. The monetary costs associated with both the development of the skill analysis training program and the practical assignment evaluation tools were considered minimal.

2. The costs associated with client's application of the skill analysis approach were considered negligible.

SUPPLEMENTAL LEARNING

The following observations were made:

1. The introductory biomechanics refresher sessions provided a useful review of terms, concepts, and principles, and resulted in the subjects' adoption of a common glossary of terms.
2. The inclusion of numerous class and small group activites were considered key to the success of the training program.
3. The testing procedures associated with the final practical assignment had a significant impact on the subjects' appreciation for the systematic approach to the skill analysis process.
4. The implementation of the skill analysis training program during the month of November in the University environment, was deemed undesirable.
5. The skill analysis paradigm was determined to be an approach which accounted for the the analyses of performers who displayed inconsistent movement patterns.
6. The training program highlighted the universality of the skill analysis paradigm.
7. The development of lists of common critical features may provide a superior alternative to the development of lists of common performance errors.

CONCLUSIONS

Within the limitations of this investigation, the following conclusions appear justified:

1. Training physical educators and coaches to analyze performances of gross motor skills appears to be a complex process that requires a considerable amount of instruction and

practice time.

2. The results of this study indicated that the skill analysis paradigm could be adopted universally. Possible applications ranged from the inclusion of the approach in the undergraduate physical education and teacher preparation programs, to the development of inservice experiences for coaches, judges, and referees. The functional potential of the skill analysis paradigm was attributed to the systematic and thorough approach to an area which has typically been neglected, or perceived as confusing and frustrating.
3. Based on the existence of minimal baseline variability and clear and consistent improvements in the performance percentage for both the identification of errors and the determination of primary errors the application of the skill analysis paradigm was concluded to evoke a positive change in skill analysis competency for the subjects in this study.
4. Based on the consideration of both the experimental and therapeutic criteria the skill analysis paradigm was deemed to be an appropriate means of changing skill analysis competency.

IMPLICATIONS AND RECOMMENDATIONS

Research related to the development of analytic proficiency, has with few exceptions, highlighted the weak influence that undergraduate courses in kinesiolgy and biomechanics have exerted. The results of this investigation have clearly demonstrated that training physical educators and coaches to analyze performance technique is both possible and functional. Furthermore, it has demonstrated the potential for a successful link between the area of biomechanics and skill teaching.

Skill analysis competency was shown to be strongly influenced by the content and structure of the skill analysis paradigm. Further development on the training program associated with the holistic approach to skill analysis oulined in this research, should effect the direction of future undergraduate curriculums.

The results of this study also have implications for the inservice certification of teachers, coaches, judges and referees. While the approach was developed and implemented as a generic approach to the process of skill analysis, sport or movement specific programs are clearly a possibility.

The adoption of intervention techniques designed to improve teacher and coach analytic proficiency proved to be an effective and rewarding approach. In addition, the functional relationships between the interventions and the individuals in this investigation were successfully evaluated using a single subject research design. The use of intervention techniques and single subject design lends itself to future experimental research in the field of teaching, coaching, and skill analysis.

The following recommendations are offered for future research.

1. A greater number of subjects and groups of subjects with similar movement experiences should be included in future investigations of the skill analysis training program.
2. The suitability of training inexperienced observers to use the concept of predictive features needs to be re-addressed.
3. The implementation of future skill analysis training programs should include an evaluation of the effects of increased emphasis on the practice components for the identification of critical features and the determination of the primary errors in skill performances.
4. There is a need to examine the degree of theoretical competence that is required for the skill analysis process.
5. The methods by which instructors of the skill analysis training program will be certified need to be considered.
6. There is a need to investigate the role that the planning for observation stage plays on the perceptual processes.
7. There is a need to investigate the effect that the application of the skill analysis paradigm has on the perceptual and diagnostic components of the analysis process.

8. The suitability of the skill analysis paradigm for the analysis of open skills needs to be examined.
9. There is a need to determine the validity of training subjects to analyze performances of gross motor skill in the simulated context.

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APPENDICES

APPENDIX 1: PFT COURSE OUTLINE

COURSE SYLLABUS - EDUC 599

COURSE TITLE: STRATEGIES FOR THE OBSERVATION AND ANALYSIS OF MOTOR SKILLS

This course will attempt to unify, organize, and integrate gross-motor skill analysis procedures in an holistic approach.

DATE: June 2 - 27, 1986
TIME: T.B.A.
PREPARED BY: Moira McPherson
OFFICE: P305
PHONE: 432-5503

I. COURSE OBJECTIVES

1. To provide strategies for skill analysis.
   Specific course objectives are:
   a. Appreciation of the nature and scope of skill analysis.
   b. Identification of critical features.
   c. Construction of an observation plan.
   d. Adoption of visual search, monitoring, and recording strategies.
   e. Error detection and priorization.
   f. Assimilation of outcome information.
2. To provide practice for the application of movement analysis skills.

II. COURSE CONTENT

The ability of teachers to form accurate feedback based on qualitative analyses implies the systematic and critical observation of motor skill performances and the subsequent identification of flaws. It is an ability which requires both the abstract analysis of a task as well as a visual dissection of the observed performance. The quality of feedback rests on the development of this skill.

Skill analysis consists of four major phases: (a) pre-observation, (b) observation, (c) diagnosis, and (d) remediation. This course will address each of these phases as a module. Associated with each module will be instructional units consisting of target goals, instruction, learner and practice activities, feedback, resources, visual materials and assessment. Students will be expected to successively master the skills in each of the modules.

Week 1 - Introduction, basic mechanical principles, movement analysis
Week 2 - Observation
Week 3 - Diagnosis
Week 4 - Remediation, feedback

III. EVALUATION

Evaluation will be based on class participation, module tasks, and assignments.

APPENDIX 2: PFT COURSE SCHEDULE

PRELIMINARY FIELD TEST SCHEDULE

DATE	TIME
11/06/86	1:00-4:00pm
12/06/86	1:00-4:00pm
13/06/86	9:00-12:00pm
16/06/86	9:00-12:00pm
17/06/86	9:00-12:00pm
18/06/86	9:00-12:00pm
	1:00-4:00pm
19/06/86	9:00-12:00pm
20/06/86	9:00-12:00pm
	1:00-4:00pm
21/06/86	9:00-12:00pm

APPENDIX 3: SUBJECT QUESTIONNAIRE

WELCOME

My name is
Telephone # Daytime
Home

I would like to design our time together so that it suits your interests as much as possible. You can assist me greatly by taking the time to answer the following questions. Please respond with as much detail as possible.

Thank-you!

1. Why did you enroll in this course?

2. List your post-secondary degrees or diplomas (I am only interested in the major area of focus).

3. Outline your previous teaching experience in terms of major subjects, grade levels, number of years...

4. Outline your previous coaching experiences (ages, sex, sports, levels ie: recreational, city league...)

5. Outline your previous dance experience (participant, instructor, dance form...).

6. Have you had any experience in the field of movement education? If so elaborate.

7. What is your experience as a performer? List the activities, level of participation, and years of experience.

8. Have you had any experience as an official, referee, judge... If so elaborate.

9. NCCP Certification Level?

10. Have you ever attended any sessions, lectures, or courses that have dealt with the area of skill analysis or observation? If so elaborate.

11. List below any courses which you have taken that have dealt with any of the following subject areas: Biomechanics, Kinesiology, Functional Anatomy.

12. List in descending order of priority the 5 activities (ie: specific sports, skills, dance forms...) with which you are most familiar. This may be as a spectator, participant, coach ...

Most familiar	1.
	2.
	3.
	4.
Least familiar of these 5	5.

APPENDIX 4: PFT SKILL ANALYSIS PROGRAM OUTLINE

SESSION #1
June 11, 1986

1. Discussed:
   - Course outline
   - Evaluation procedures
   - Journal
   - Tests

2. Introduction to Skill Analysis
Discussed:
   - Feedback and the link to skill acquisition
   - Quantitative and qualtitative analysis
   - Assumption that competency in qualitative analysis is automatic
   - Lack of common thread in the traditional curriculum
   - Approaches to skill analysis (kinesiology, error memorization, NCCP)
   - Inconsistencies in terms
   - Need to synthesize components of skill analysis

Defined:
   - Observation, movement analysis, skill analysis, primary vs secondary errors, diagnosis and remediation, critical features

3. Handout: Paradigm for Skill Analysis
Discussed:
   - Target skills
   - Paradigm
   - Course focus on closed skills
   - Focus on performance technique
   - Success of model dependent on practice

4. Showed Video - Biomechancis: Qualitative Analysis (Bedingfield & McPherson, 1985).

Readings:
   Evans, J. "Movement Analysis"
   Hoffman, S.J. "Towards a Pedagogical Kinesiology"
   Armstrong, C.W. " Research on Attempts to Promote Competency in Skill Analysis"

SESSION #2
June 12, 1986

1. Reviewed basic mechanical terms and concepts (vectors, scalars, velocity, force, mass, weight, link system, C/M, linear motion, angular motion).
Principles:
   - Summation and continuity of force
   - Direction principle

- Long and Fast principle
- Stability

Activity #1: Stability in your sport (NCCP Level 2 Theory, p.9-13)
Handout: Bibliography for biomechancis and fundamental skills
Discussion:

- Definition of technique

Reading:

Norman, R. "Biomechanics for the Community Coach"

SESSION #3
June 13, 1986

1. Re-caped and review of mechanical terms and concepts.

2. Introduced, defined and discussed, examples of:
   - Projectiles (Handout: Summary - Projectiles, Diagrams showing the effect of different angles on the horizontal distance and effect of height and speed)
   - Impulse
   - Rotory motion (Handout: Summary of material covered in NCCP Level 3)
   - Activity: NCCP level 3, p. 8.8

3. Showed and discussed the NCCP Level 3 video-tape: Rotational Momentum Part 2.

4. Test #1 - Movement Analysis

5. Discussed definition of technique.

6. Introduced movement analysis:
   - Defined movement analysis
   - Introduced theoretical model (Hay & Reid, 1982)
   - Discussed need to include a final step in the movement analysis stage

7. Homework: Activity: NCCP Level 3, P. 8.8 (Review of principles)

SESSION #4
June 16, 1986

1. Re-caped movement analysis and Hay's model:
   - Example of a theoretical model: Waltz jump

2. Movement Analysis Step #1 - Determining the performance criterion
Discussed:
   - Skill which are measured objectively and subjectively (advantage vs points awarded)

- Activity: Determine the performance criterion
- Handout: List of performance criterions for different skills

3. Movement Analysis Step #2 - Breaking the performance criterion into components.

Discussed:

- How and Why?
- Examples for the high jump, swimming, long jump
- Activity: Break performance into components

SESSION #5
June 17, 1986

1. Recap of first two stages of movement analysis

Stressed:

- Step #1 may have two parts.
- Importance of simplifying the movement

2. Test #2 - Movement Analysis

3. Movement Analysis Step #3: Factors which affect the result.

Handout:

Models for four fundamental skills
Biomechanical factors that govern the effectiveness
Summary of mechanics of jumping and throwing

Discussed:

- Models and the mechanical principles that apply to each of them

4. Movement Analysis Step #4: Identification of the critical features.

Discussed:

- Examples (Waltz jump, high jump, vertical jump, long jump, overarm throw)

Activity:

Forearm pass critical features
Identify critical features for the cartwheel

5. Test #3 - Movement Analysis

Readings:

Hay & Reid - Textbook p. 266-278
Hay, J.G. "The Development of Deterministic Models"

SESSION #6
June 18, 1986

1. Reviewed critical features for the four fundamental skills. Used the filmed performances and worked through the models.

2. Planning for Observation

Discussed:
- Introduction
- Overhead on Why plan, some guides to planning

3. Test #1 - Planning for Observation

4. Planning for Observation Step #1: Re-examine and select critical features.
Discussed:
- Predictive features
- Activity: Gave list of the critical features for the cartwheel. Class re-examined and selected the least redundant set, and possible predictive features.

5. Planning for Observation Step #2: Scanning strategies.
Discussed:
- Introduction
- Activity: Gave out list of statements concerning scanning strategies, group discussion and presentations.

6. Test #2 - Planning for Observation

7. Plannning for observation Step #3: Position strategies.
Discussed:
- Guidelines
- Videotape of play school children
- Activity: Tried out a number of different positions for viewing performances of fundamental skills

8. Summary of the planning for observation stage.

9. Assigned and discussed video project.

10. Assigned as homework the development of an observation plan for the assigned project skill(all choices must be justified).

11. Test #3 - Planning for Observation

Readings:
Barrett "Observation for Teachers and Coaches"
Logsdon et al "A-Focus on The Teaching Process", (Chapter 9)

SESSION #7
June 19, 1986

1. Gave instructions for the video-taping session (timeline, equipment...).

2. Re-cap - Purpose of the project and of the session.

3. Students went to the gymnasium to work on their projects.

4. Met as a class to discuss the format for presentations.

SESSION #8
June 20, 1986

1. Assigned two hours of time to allow the groups to finish their projects (justify all choices, plan presentations, produce good copies of the plan).

2. Class presentations:
    - 45 minutes per group
    - Question period and discussion
    - My questions and suggestions
    - General summary of projects

3. Consideration of the direct and indirect constraints on the observation process.
Discussed:
    - Introduction and definitions
    - Factors which alter perception
    - Other relevant correlates
    - Class discussed various examples and related the concepts to their own experiences

4. Acceptable Response Range
Discussed:
    - Introduction and definition.
    - Activity: Homework - complete stick figure drawings of acceptable response range

SESSION #9
June 21, 1986

1. Collected stick figure activities and discussed the merit of the assignment.

2. Diagnosis and Remediation

Discussed:
    - Introduction and definitions
    - Handout: Hoffman's model - Discussed and worked through a number of examples using the model
    - Defined primary and secondary errors.

Activity:
    - Identify and determine the primary and secondary errors from the filmed performances of the play school children
    - Apply Hoffman's model to the discrepancies between the observed and desired responses recorded for the video projects.

3. Summary of the skill analysis paradigm.

4. Handout: Great Quotes - Discussed each of the quotes and their relation to the development of the skill analysis paradigm.

Reading:
    Hoffman, S.J. "Clinical Diagnosis"

APPENDIX 5: VIDEO PROJECT

ACTIVITY - VIDEO PROJECT

GROUP
SKILL
PERFORMANCE CRITERION
PERFORMER

PURPOSE: TO DEVELOP AN OBSERVATION PLAN AND RECORDING INSTRUMENT AND TO APPLY THE SELECTED OBSERVATION STRATEGIES TO THE OBSERVATION OF THE ASSIGNED SKILL.

PROCEDURE:

1. Each group member must develop an observation plan for the assigned skill. The plan should include the critical features to be observed in each observation of the skill, the purpose for observing these critical features, selected predictive features, as well as the scanning and position strategies to be used for each observation.. You must be able to justify all your choices.
2. Meet with your group and share ideas concerning the plans. Develop one plan and a corresponding recording instrument. Determine an acceptable response range for each of the critical features you have selected to observe.
3. Each group will receive a video system and an assigned work place. Take your equipment and practice applying the observation plan by making a video recording of the performances of your assigned skill. Use the camera controls to simulate the human eye.
4. View each of the recorded trials and complete the developed recording instrument. Prepare a good copy of the plan, recording instrument etc... to be photocopied for each member of the class. Discuss and practice your groups presentation of the project.
5. Class presentations.

PRESENTATIONS:

- Approximately 45 minutes per group.
- Introduce and present the observation plan, recording instrument, and acceptable response range.
- Explain and demonstrate all components of the plan using the prepared video.
- As you present each of the observations state the observed responses.
- All decisions related to the observation plan choices must be justified.

APPENDIX 6: SUMMARY OF THE RESULTS OF THE PFT

MOVEMENT ANALYSIS INSTRUCTIONAL UNIT

INTRODUCTION:

- The introduction of this stage should include more information on how the conceptual analysis of a skill fits into the skill analysis paradigm, and what the target goals are. S1,7,8,2
- The transition from the review of the basic mechanical principle to the movement analysis stage was rough. S1

DETERMINE PERFORMANCE CRITERION

- A lack of knowledge on how a skill was evaluated created some confusion. S2,5
- Following the presentation of an example the performance of the skill should be described. State how it is measured. S2,6,8,
- The examples of skills which were evaluated subjectively created confusion. S3,5,7
- Different use of terminology caused difficulties. S3,4,8,

SIMPLIFY MOVEMENT AND DETERMINE MECHANICAL CONSTRUCTS

- Experienced difficulty in trying to simplify the movement when there was a lack of knowledge of the skill. S2,8
- Experienced difficulty in breaking the skill down to a level where only the mechanical determinants were considered. S4
- Initially confused in the distinction between mechanical factors and critical features. S7,3
- Concerned with ability to determine the mechanical factors without a strong biomechanical background. S1,5,7

IDENTIFY CRITICAL FEATURES

- There is a need to spend more time practicing the determination of critical features using film as an aid. S2
- There is a need to assign the determination of critical features for a new skill then spend time discussing and providing feedback. S1,2,5,6,8,

MOVEMENT ANALYSIS ACTIVITIES

DETERMINE PERFORMANCE CITERION

- Need to be more specific in the skills chosen as examples ie: state cross-country ski loppit vs cross-country ski racing. S2,3,7
- Difficult to determine for skills which are measured subjectively. S3
- Good activity, put theory into practice. S1,5,8

SIMPLIFY PERFORMANCE MOVEMENT

- Need more initial information on the performance of the skill. S8
- Be more specific on the skills which are chosen. S6
- Good activity, would have liked an opportunity to do some more for homework. S1
- Good activity. S5

CRITICAL FEATURE DEMO

- good activity. S1,2,3,4,5,6,7,8

CARTWHEEL CRITICAL FEATURES

- Good activity. S1,2,3,4,5,6,7,8

FILM

- More time needed to go over the examples on film. S2
- Good activity. S1,2,3,4,5,6,7,8

MOVEMENT ANALYSIS READINGS

Hoffman

- Really enjoyed, the reading complimented the course content. S1,3,2,5,6,7

Armstrong

- Enjoyed, complimented course content. S1,2,3,5,7

Evans

- Not very informative. S1
- Provides sound rationale for learning mechanical principles. S2

Norman

- Good. S1,2,7

PLANNING FOR OBSERVATION INSTRUCTIONAL UNIT

INTRODUCTION:

- The introduction should include a clear description of where the planning for observation stage fits into the skill analysis paradigm and what the significance of the target goal is. S5
- The provision of a completed observation plan would help to give a visual picture of the target goal. S4

IDENTIFY PREDICTIVE FEATURES

- The instruction on the identification of predictive features created alot of confusion. More elaboration, explanation and examples were needed. S1,2,3,5,6,7,8

DETERMINE NUMBER OF OBSERVATIONS

- Need more instruction on selecting the optimal number of observations. S8
- Not enough elboration on the relationship between the number of observations and the consistency of the performance. S2,6

SCANNING

- The examples did not stress the importance of priorizing the scanning strategies. S1

PLANNING FOR OBSERVATION ACTIVITIES

RE-EXAMINE CRITICAL FEATURES

- Excellent activity. S1,2,5

SCANNING STRATEGIES

- Excellent activity, evoked good discussion. S2,3,5,6,7

POSITION STRATEGIES

- Need to have clearly identified critical features prior to completing this activity.

PLANNING FOR OBSERVATION READINGS

Barrett

- Good reading, provided extra examples. S1,2,7,

Logsdon

- Good reading. S1,2,7
- Undergraduates may have difficulty with terms. S1

ACCEPTABLE RESPONSE RANGE INSTRUCTIONAL UNIT

-The unit should be addressed following the section on the identification of critical features. S1
- The unit should be covered during the development of the observation plan. S6
- The presentation of a system of notation would greatly facilitate the use of the practical application of this unit. S4

DIAGNOSIS AND REMEDIATION INSTRUCTIONAL UNIT

- There is a need to add an option for environmental and psycho-social problems. S1
- The model requires more pathways to pursue perceptual errors. S6
- More practice time for the identification of errors is required. S1

DIAGNOSIS AND REMEDIATION ACTIVITIES

IDENTIFY PRIMARY ERRORS

- Very useful activity. S1,2,5,6,7

IDENTIFY ERRORS IN A PERFORMANCE

- Good opportunity to formulate and discuss ideas. S1,5,6,8,

APPENDIX 7: BIOMECHANICS QUIZ

EXERCISE ON THE REVIEW OF THE MECHANICAL PRINCIPLES

CIRCLE THE CORRECT ANSWER

1. A method by which an athlete can produce rotational motion is:
   a. maintainance of inertia
   b. transference of momentum
   c. redundance of inertia
   d. rotational difference of body parts

2. An athlete can make the upper limb rotate more quickly by:
   a. reducing the muscular force
   b. reducing the limbs moment of inertia
   c. using all available joints in the reverse order of their size
   d. using only the large muscle groups

3. Athletes' rotational momentum depends on the combination of their moment of inertia and their:
   a. mass
   b. total body inertia
   c. rotational velocity
   d. linear velocity

4. A person failing to gain sufficient rotation to complete a somersault would be advised to apply:
   a. less force nearer the centre of mass
   b. more force nearer the centre of mass
   c. less force farther from the centre of mass
   d. more force farther from the centre of mass

5. Momentum is the product of:
   a. weight and velocity
   b. mass and velocity
   c. weight and speed
   d. weight and mass

6. The application of an off-centre force to a basket-ball will cause:
   a. the ball to spin
   b. the ball to move faster toward the basket
   c. the ball to spin more slowly
   d. the shooter to be more off-balance

7. Impulse is a combination of:
   a. speed and force
   b. force and velocity
   c. force and time
   d. time and speed

8. Athletes should not be expected to comply with the straight and strong principle (IMPULSE) when they are:
   a. maintaining rather than increasing speed

b. starting to move from a dead stop
c. moving at a moderate stroke rate
d. Projecting a javelin

9. When a swimmer zigzags down the pool the problem is most likely:
    a. a lack of leg strength resulting from a weak link
    b. arm movements which push to the side rather than to the back
    c. a vertical rather than horizontal body position
    d. a result of improper breathing technique

10. An unstable position is characterized by:
    a. a low centre of mass
    b. a large base of support
    c. an increased mass
    d. a high centre of mass

11. When an athlete uses a long stick or club, he/she may lose some:
    a. speed
    b. control
    c. force
    d. momentum

12. The speed of an object being thrown is most clearly related to the:
    a. position of the upper body at release or contact
    b. speed of the arm at release or contact
    c. speed of the hand at release or contact
    d. angle at which the object is thrown

SHORT ANSWER

1. Define the terms; VELOCITY, SPEED.
2. Provide 3 different examples of forces that affect the movement of humans.
3. Briefly explain the advantage of considering the position of the centre of mass when analyzing skills.
4. Which variable are you most interested in maximizing when you are projecting a body or object for vertical distance (height)?
5. Which variables affect the horizontal distance (range) attained by a projected object?

APPLICATION OF THE MECHANICAL PRINCIPLES

Imagine the coach with all these problems! Decide which principle(s) are being violated.

1. The baseball player can't make the throw all the way to third base.
2. By the time Harry, the basketball player, pivots the defence is ready to block the shot.
3. When Jane delivers the bowling ball, it never has enough "umph" to knock over the pins.
4. The number 3 man never gets his paddle in the water on time.
5. The skip's curling rock never curls.
6. Jack always lands flat on his back when he tries a somersaulting dive.
7. The second never throws enough weight to make the double take-out (curling).
8. The field goal kicker always kicks the ball off to the left of the goal posts.
9. Bill's slapshot has the speed of a turtle.
10. The team rows a zig-zag course.
11. Rose spends half the race skiing and the other half falling down and getting up.
12. The triple jumper usually lands on his bottom.
13. The trampolinist can do a triple somersault but he lands on the floor.
14. Valerie, the volleyball spiker can never get any spin on her spike.
15. The horse never clears the higher jumps.

(Adapted from NCCP: Level 111, p. 8-22)

APPENDIX 8: DESCRIPTION OF THE FFT SKILL ANALYSIS TRAINING PROGRAM

WELCOME TO STRATEGIES FOR OBSERVATION AND ANALYSIS OF MOTOR SKILLS

SESSION #1: Tuesday, November 4, 1986
8:15 - 9:45PM

Session Objectives:

- To introduce themselves and present a brief overview of their background and interests to the rest of the group.
- To follow through the course outline.
- To consider the nature and extent of the skill analysis process.

Lesson Outline:

1. Introductions
2. Present and explain the course outline. Discuss the class format and the evaluation procedures. Allow five minutes for questions on the course outline.
3. Arrange participants into groups of 2 or 3 and assign Activity #1: What is Skill Analysis? Allow approximately 15 minutes for the groups to discuss and complete the activity. Have a spokesperson from each group report. Synthesize and discuss the responses to the questions. Lead the discussion into a discussion on a form of skill analysis which has a focus on technique.
4. Define technique (see Overhead #1).
5. State the assumptions of the skill analysis training program (see Overhead #1).

Readings:

1. Evans, J. "Movement Analysis" The Leaflet; The Physical Education Association of Great Britain and Northern Ireland. Vol 66, No. 6, July, 1965, p. 51-53.

2. Hoffman, S.J. "Towards a Pedagodical Kinesiolgy" Quest, No. 4, 1986.

COURSE SYLLABUS - EDUC 498

COURSE TITLE:
STRATEGIES FOR THE OBSERVATION AND ANALYSIS OF MOTOR SKILLS

This course will attempt to unify, organize, and integrate gross-motor skill analysis procedures in an holistic approach.

DATE: November 4-30, 1986
TIME: T 8:15-9:30pm, R 7:00-10:00pm, SAT 9:00-12:00pm, SUN 9:00-12:00pm
PREPARED BY: Moira McPherson
OFFICE: P305
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I. COURSE OBJECTIVES

1. To provide strategies for skill analysis.
   Specific course objectives are:
   a. Appreciation of the nature and scope of skill analysis.
   b. Identification of critical features.
   c. Construction of an observation plan.
   d. Consideration and adoption of visual search, monitoring, and recording strategies.
   e. Error detection and priorization.
2. To provide practice for the application of movement analysis skills.

II.COURSE CONTENT

The ability of teachers to form accurate feedback based on qualitative analyses implies the systematic and critical observation of motor skill performances and the subsequent identification of flaws. It is an ability which requires both the abstract analysis of a task as well as a visual dissection of the observed performance. The quality of feedback rests on the development of this skill.

Skill analysis consists of four major phases: (a) pre-observation, (b) observation, (c) diagnosis, and (d) remediation. This course will address each of these phases as a module. Associated with each module will be instructional units consisting of target goals, instruction, learner and practice activities, feedback, resources, visual materials and assessment. Students will be expected to successively master the skills in each of the modules.

III EVALUATION

1. Journal (30%)
2. Class Activities & Assignments (15%)
3. Participation (15%)
4. Video Project (20%)
5. Practice and Application (20%)

JOURNAL

30 % OF TOTAL GRADE
DUE DECEMBER 10, 1987

1. Daily journal entry for each session.
Outline:

- Session objectives
- How did the instructor attempt to meet these objectives?
- Which activities, discussion...were particularly helpful? Why?
- Which activities, discussions...were confusing? Why?
- Did the session raise any reactions, revelations, queries...?
- Recommendations on how to improve the session.

2. End of course summary.

- Has your understanding of the analysis process changed? How?
- Will your approach to the analysis process change as a result of this course? If so explain how?
- Do you feel that you could apply the skill analysis paradigm to the analysis of other skills or movements not covered in the course sessions?

What was your:

- Overall impression of the skill analysis paradigm?
- Overall impression of the visual materials?
- Overall impression of the readings?
- Overall impression of the activities and tasks?

Were the time constraints imposed satisfactory?
Any Recommendations?

NOTE: The quality of journal will be significantly enhanced by the inclusion of personal experiences, insights, and reflections.

ACTIVITY #1: INTRODUCTION TO SKILL ANALYSIS

(10-15 Minutes)

Working in groups of two or three discuss any experiences you may have had with "skill analysis". Determine a definition of what you consider skill analysis to be.

Consider the following:

How do you approach the skill analysis process?
What do you consider to be the most important components of the skill analysis process?
What do you consider to be the focus or purpose of skill analysis?

OVERHEAD #1

TECHNIQUE:

Technique is respected when different motor components combine in a logical sequence, when there is a summation of forces with these forces being directed in the direction of the movement. (Salmella, 1974, p. 101)

- Manipulate the performer through the correct mechanical pathways.
- The movement patterns which are dictated by the requirements and constraints of the skill or activity.

FEEDBACK:

A teaching behavior that is dependent upon the motor responses or one of more students and is intended to provide information relevant to the acquisition or performance of a motor skill. (Fishman & Anderson, 1971)

ASSUMPTIONS OF THE SKILL ANALYSIS TRAINING PROGRAM

1. Focus on technique
2. Focus on the analysis of closed skills
3. Improvement is dependent upon the systematic application and practice of the skill analysis strategies.

INTRODUCTION TO THE PROCESS OF SKILL ANALYSIS

SESSION #2:
Thusday, November 6, 1986
7:00 - 10:00PM

Session Objectives:
- To view and discuss their reactions to the instructional videotape: Biomechanics: Qualitative analysis.
- To gain an overview of the research and literature regarding the components of the skill analysis process, and attempts to train skill analysis.
- To examine a holistic approach to the skill analysis process.

Lesson Outline:

1. Recap last session.
2. Discuss "Towards a Pedagogical Kinesiology"
3. Discuss the development of the instructional videotape: "Biomechanics: Qualitative Analysis"
4. Present the videotape and discuss.
5. Present a review of the literature.
   Topics: - Components of the skill analysis process (see Overhead #2)
   - Approaches to the process of skill analysis.
   - Attempts to train skill analysis competency.
   - Critique of the research to date.
6. Present operational definitions (Handout #1: DEFINITION OF TERMS).
7. Present the skill analysis paradigm (Handout #2: SKILL ANALYSIS PARADIGM). Explain each of the components in the holistic approach to skill analysis. Explain the parallel between the paradigm and the flow of the training program.

Readings:
1. Armstrong, C.W. Research on Movement Analysis: Implications for the Development of Clinical Competence, 1983.
2. Norman, R.W. Biomechanics for the Community Coach. JOPER, March 1975, p. 49-52.

On Reserve:
1. Bedingfield, E.W., McPherson, M.N. Biomechanics: Qualitative Analysis, An Instructional Videotape. S&F International, 1984

HANDOUT #1: DEFINITION OF TERMS

Observation. In accordance with the definition supplied by Lewis (1980), observation is concerned with sensation, perception, and attention to a visual stimulus.

Movement Analysis. Movement analysis refers to the conceptual breakdown or analysis of a skill or movement. The main characteristics of this process are: definition of the purpose or goal, a movement simplification, identification of mechanical determinants, and the identification of critical features.

Primary & Secondary Errors. Errors may be primary or secondary. A primary error is an error which is the main problem and should be the focus of remediation. Secondary errors are problems or errors which are symptoms of larger errors ie. the primary errors. Secondary errors are important as they may furnish important information concerning the primary errors, however, efforts to correct the secondary error will not correct the real problem.

Skill Analysis. The term skill analysis refers to a process which includes; conceptually analyzing a movement, observing the performance of a movement, diagnosing discrepencies between the desired response and the observed response, and forming and providing remediation. Skill analysis is precursor to the provision of feedback.

Technique. Technique is respected when different motor components combine in a logical sequence, when there is a summation of forces with these forces being directed to the most mechanically efficient performance of a movement pattern within the constraints and requirements of the skill or activity.

Training Program. A method of training teachers or coaching which combines and presents the elements of a number of instructional units.

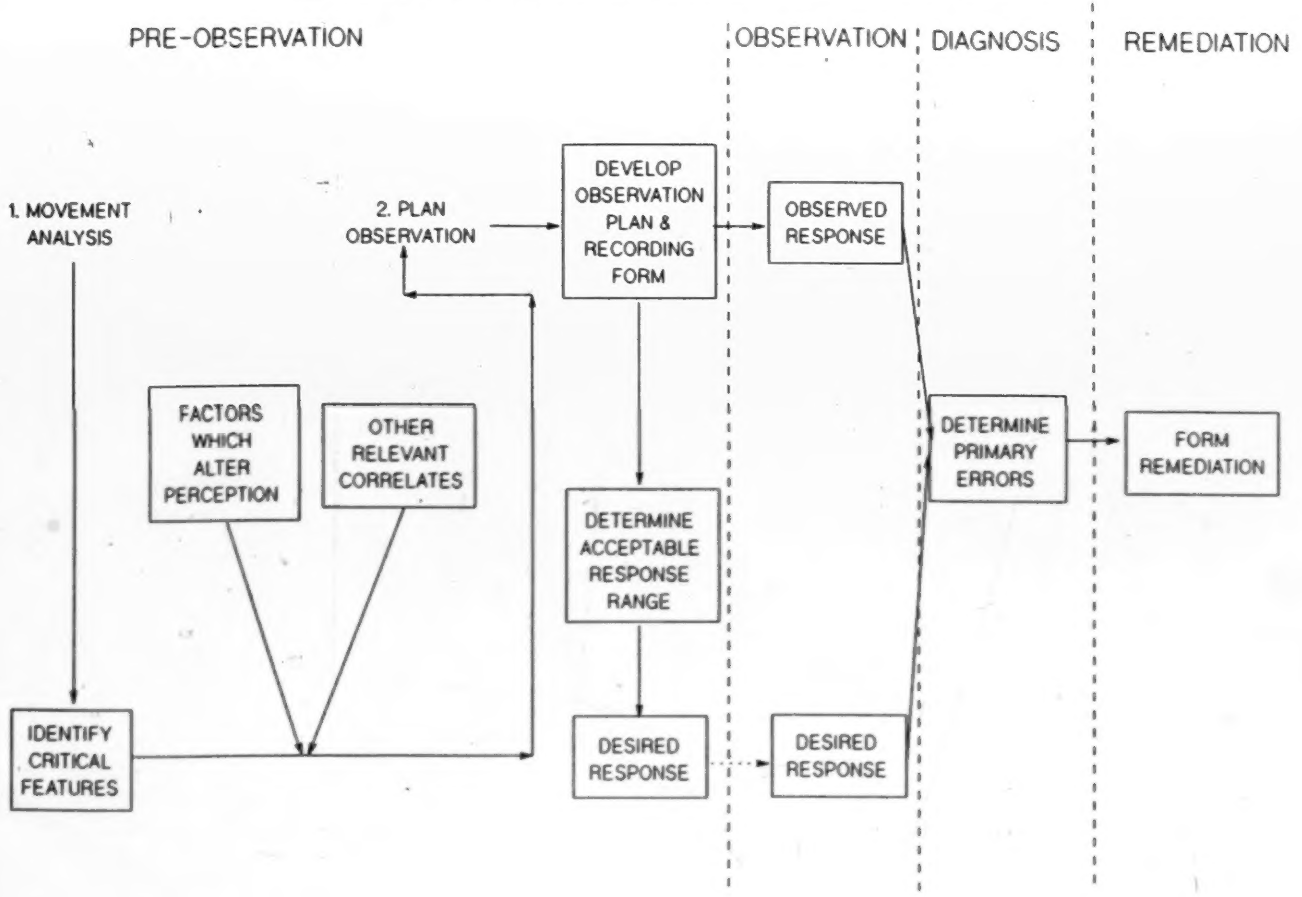
OVERHEAD #2

- Analytic tasks required by teachers and coaches are qualitative in nature.

FOUR COMPONENTS OF THE SKILL ANALYSIS PROCESS:

1. Pre-observation
2. Observation
3. Diagnosis
4. Remediation

HANDOUT #2: SKILL ANALYSIS PARADIGM TARGET SKILLS



INTRODUCTION TO THE MOVEMENT ANALYSIS STAGE

(SESSION 3 & 4 REVIEW OF MECHANICS)

SESSION #5:

Tuesday, November, 11, 1986
2:00 - 5:00PM

Session Objectives:

- To complete the Biomechanics quiz
- To outline the first phase of the skill analysis paradigm: pre-observation
- To outline the first stage of pre-observation: Movement analysis
- To detail the process involved in the identification of the performance criterion
- To detail the process involved in the simplification of the performance criterion.

Lesson Outline:

1. Assign the biomechanics quiz as a review activity for students.
2. Introduce the first phase of the skill analysis paradigm. Refer to handout #1 and re-define the key components of the phase.
3. Introduce the first stage of the pre-observation phase: Movement analysis(Handout #3: MOVEMENT ANALYSIS). Briefly define and explain each of the steps in the movement analysis stage. Define and explain the significance of the target goal, the identification of the critical features.
4. Relate the movement analysis stage to a description of the development of a theoretical model (Hay & Reid, 1982)(see Overhead #3). Present an example of theoretical model (see Overhead #4)
5. Define and detail the steps involved in identifying the performance criterion. Provide examples (vertical jump, long jump, cartwheel, and overarm throw).
6. Assign Activity #2: IDENTIFYING THE PERFORMANCE CRITERION. Allow approxiamately 10-15 minutes for each of the groups to discuss and complete the activity. Have a spokesperson report the results from each of the groups. Discuss the responses.
7. Handout: CLASSIFICATION OF RESULTS FOR SELECTED SKILLS.
8. Define and detail the steps involved in the simplification of the performance criterion. Provide examples.
9. Assign Activity #3: SIMPLIFICATION OF THE PERFORMANCE CRITERION. Provide each group with two different activities to simplify based on their specific sport interests. After approximately 10 minutes have each group describe their assigned skill, the performance criterion and the simplication of the performance criterion.

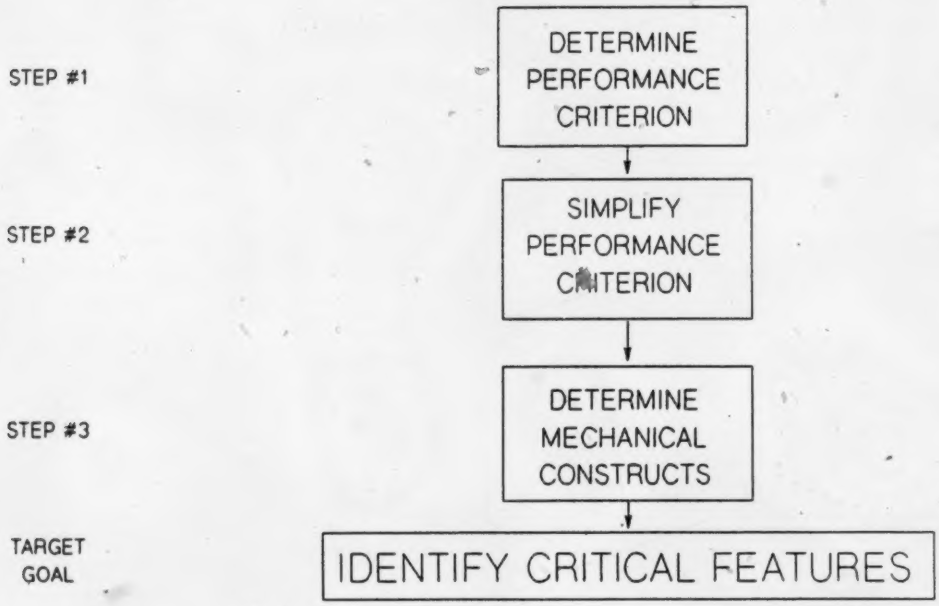
Readings:

1. Hay, J.G. & Reid, J.G., The Anatomical and Mechanical Bases of Human Motion. p. 266-278.

HANDOUT #3: MOVEMENT ANALYSIS

PRE-OBSERVATION

1. MOVEMENT ANALYSIS



STEP #1: DETERMINE PERFORMANCE CRITERION

STEP #2: SIMPLIFY PERFORMANCE CRITERION

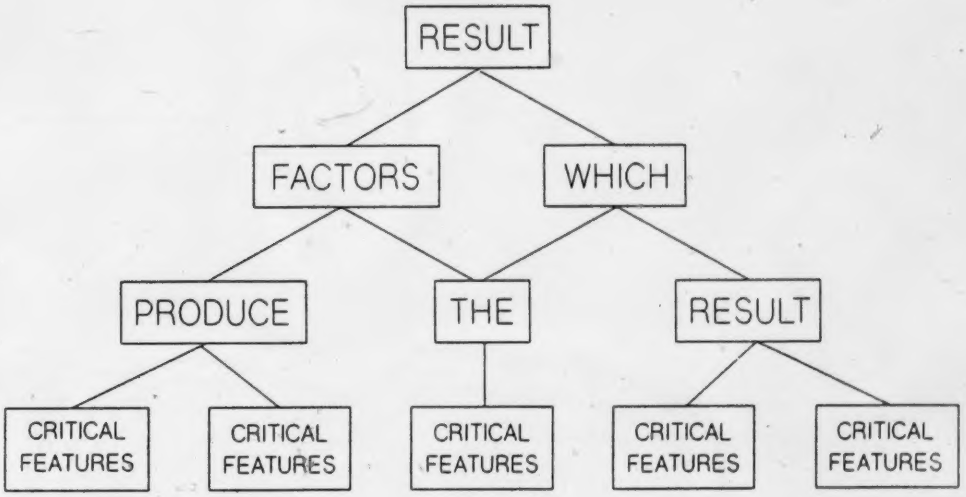
STEP #3: DETERMINE MECHANICAL CONSTRUCTS

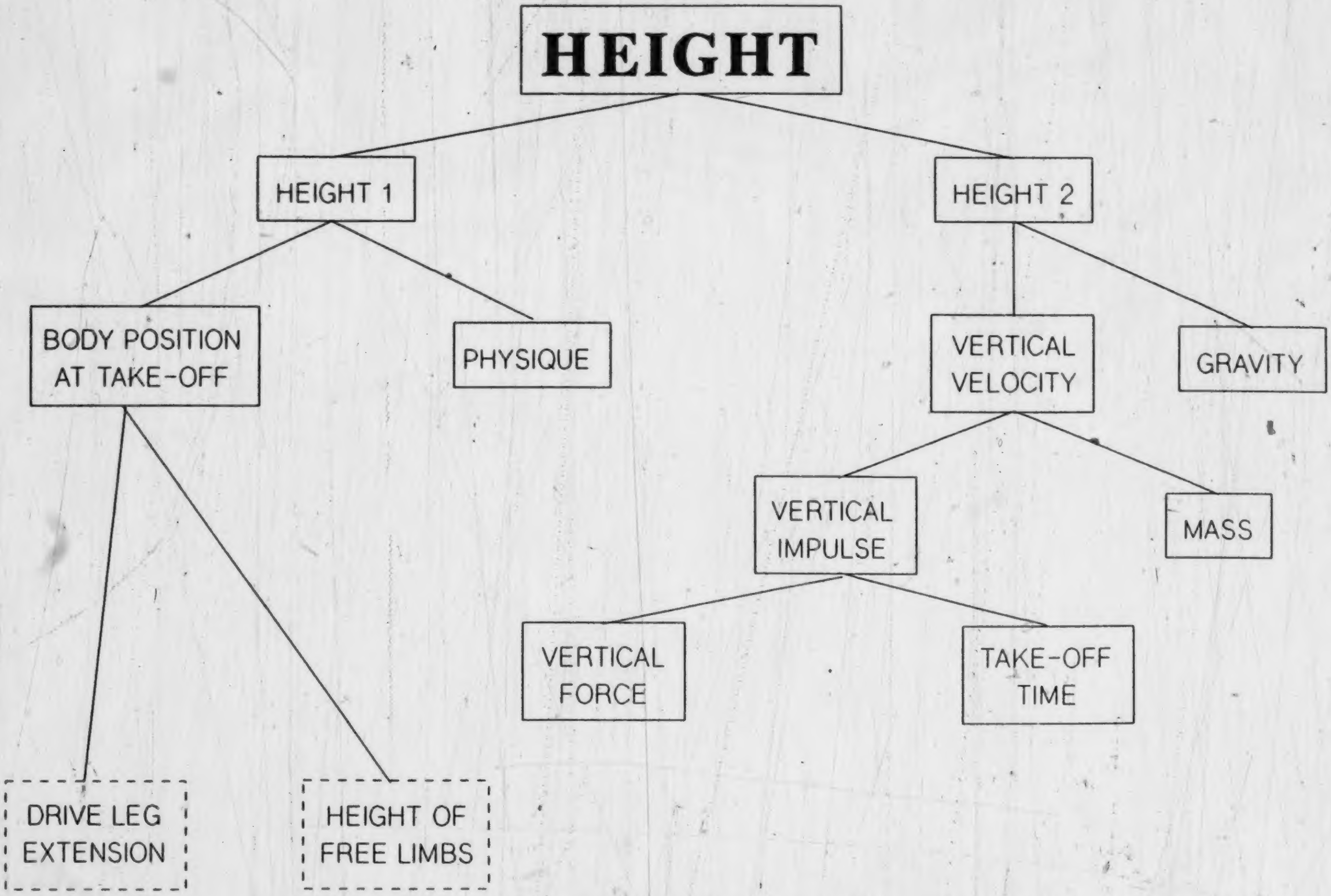
TARGET GOAL: IDENTIFY CRITICAL FEATURES

OVERHEAD #3

MOVEMENT ANALYSIS

- The conceptual analysis and organization of movement.
- The development of a theoretical model(Hay & Reid, 1982) is used as a basis for identifying errors and judging their relative importance.
-The theoretical model shows the relationship between the result and the factors that produce the result.





OVERHEAD #4: A THEORETICAL MODEL FOR THE WALTZ JUMP

ACTIVITY #2: IDENTIFICATION OF THE PERFORMANCE CRITERION
(10-15 Minutes)

Determine the performance criterion for the following skills.

1. A discus throw
2. The swan dive
3. A cross country ski loppit
4. Downhill ski racing
5. A dance leap
6. A pass in basketball
7. A soccer kick
8. The slapshot
9. The 100 yard sprint
10. A shotput
11. The forearm pass in volleyball

ACTIVITY #3: SIMPLIFICATION OF THE PERFORMANCE CRITERION
(10-15 Minutes)

For the following skills simplify the movement by determining if the performance criterion can be divided into a series of distinct parts.

1. Cross country skiing for distance
2. The jump and reach
3. The shotput
4. The triple jump
5. Walking
6. A ski jump

MOVEMENT ANALYSIS

SESSION #6:
Thursday, November 13, 1986
7:00 - 10:00PM

Session Objectives:

- To detail the process involved in the determination of the mechanical constructs.
- To define and detail the process involved in the identification of the critical features.
- To practice the identification of critical features.

Lesson Outline:

1. Recap the first two steps of the movement analysis stage.
2. Define and detail the steps involved in the determination of the mechanical constructs (Handout: BIOMECHANICAL FACTORS THAT GOVERN THE EFFECTIVENESS OF SELECTED PERFORMANCES).
3. Provide students with a resource package containing information on the application of mechanics to the selected example skills.
4. Go over the mechanical factors for Handout #4: THEORETICAL MODELS (vertical jump, cartwheel, long jump, and the over arm throw).
5. Re-define and discuss in detail critical features (see Overhead #5).
6. As a class, discuss and identify the critical features for the vertical jump and the cartwheel.
7. Assign as homework the identification of the critical features for the long jump and the overarm throw.

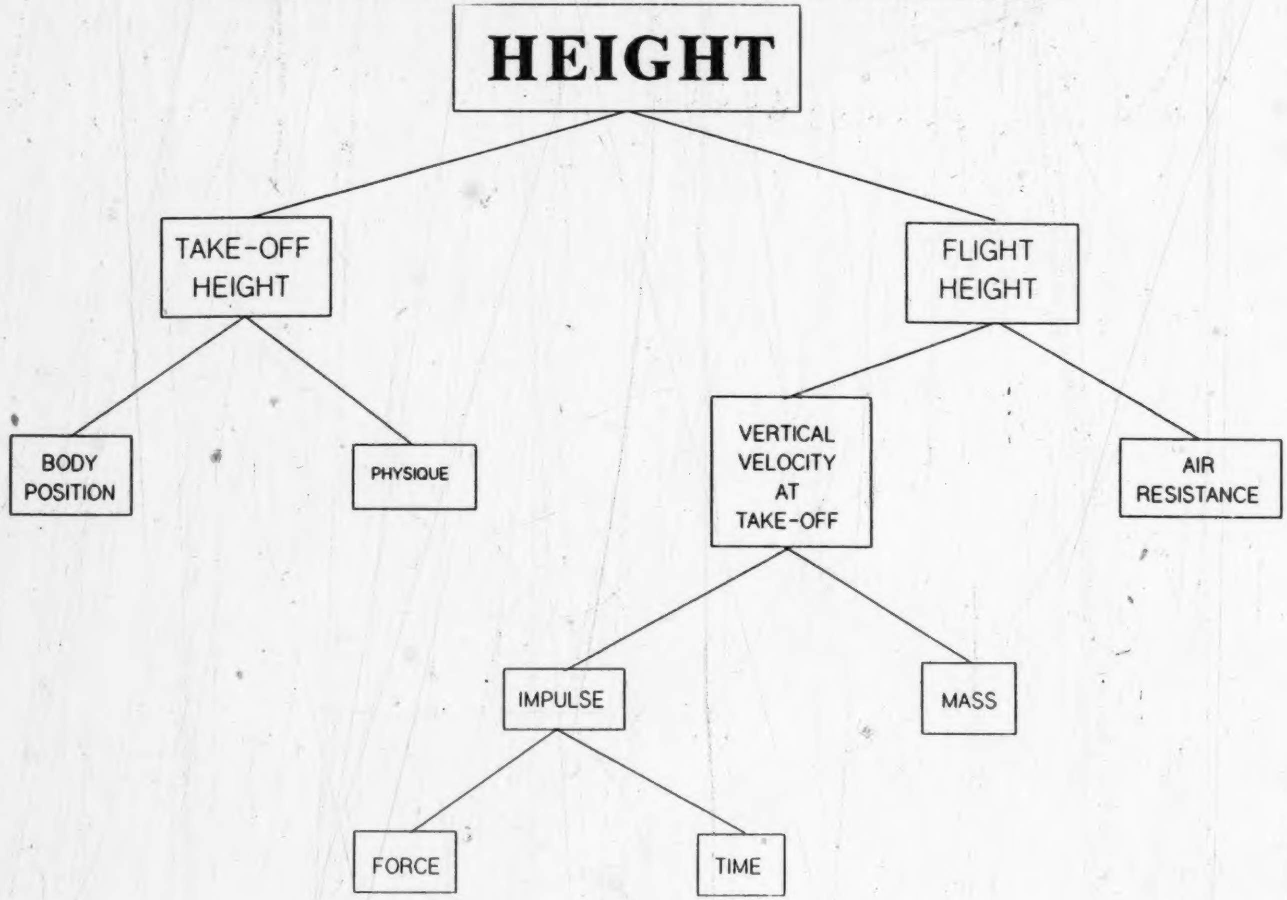
Reading:

1. Hay, J.G., The Development of Deterministic models for Qualitative Analysis.

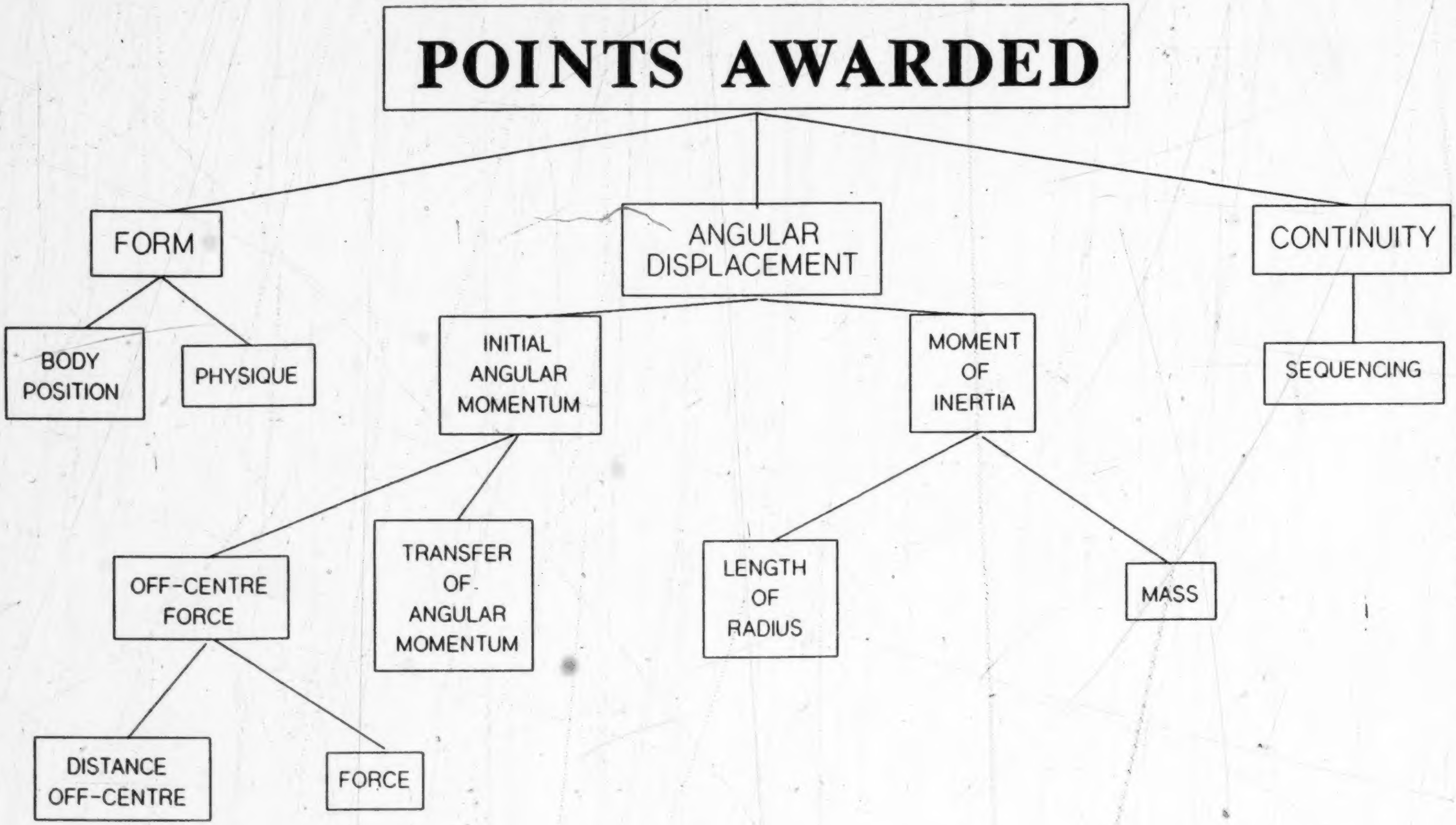
Resource Package:

- Handout #4, Kreighbaum & Barthels, 1981, p. 453 - Selection of material from texts.

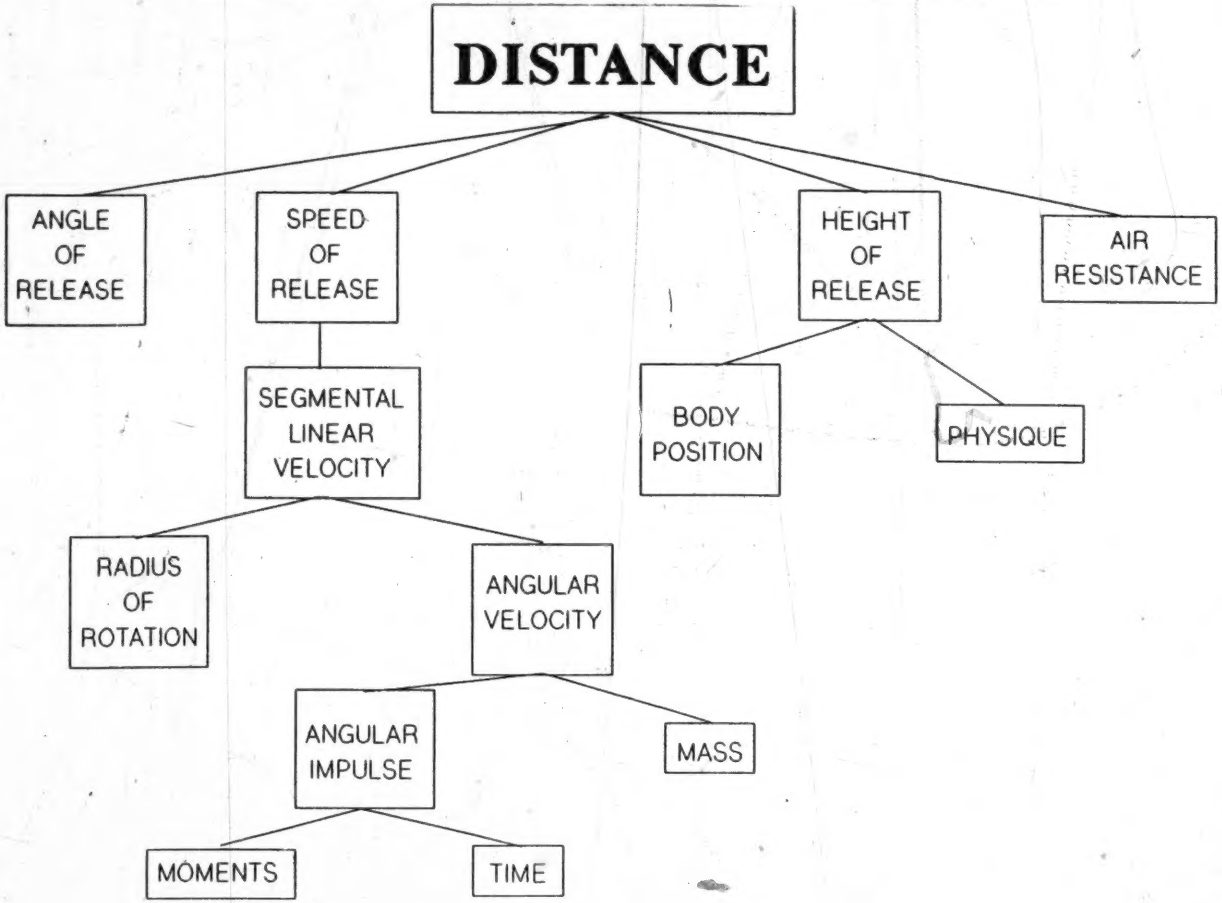
HANDOUT #4.1: A THEORETICAL MODEL FOR THE VERTICAL JUMP



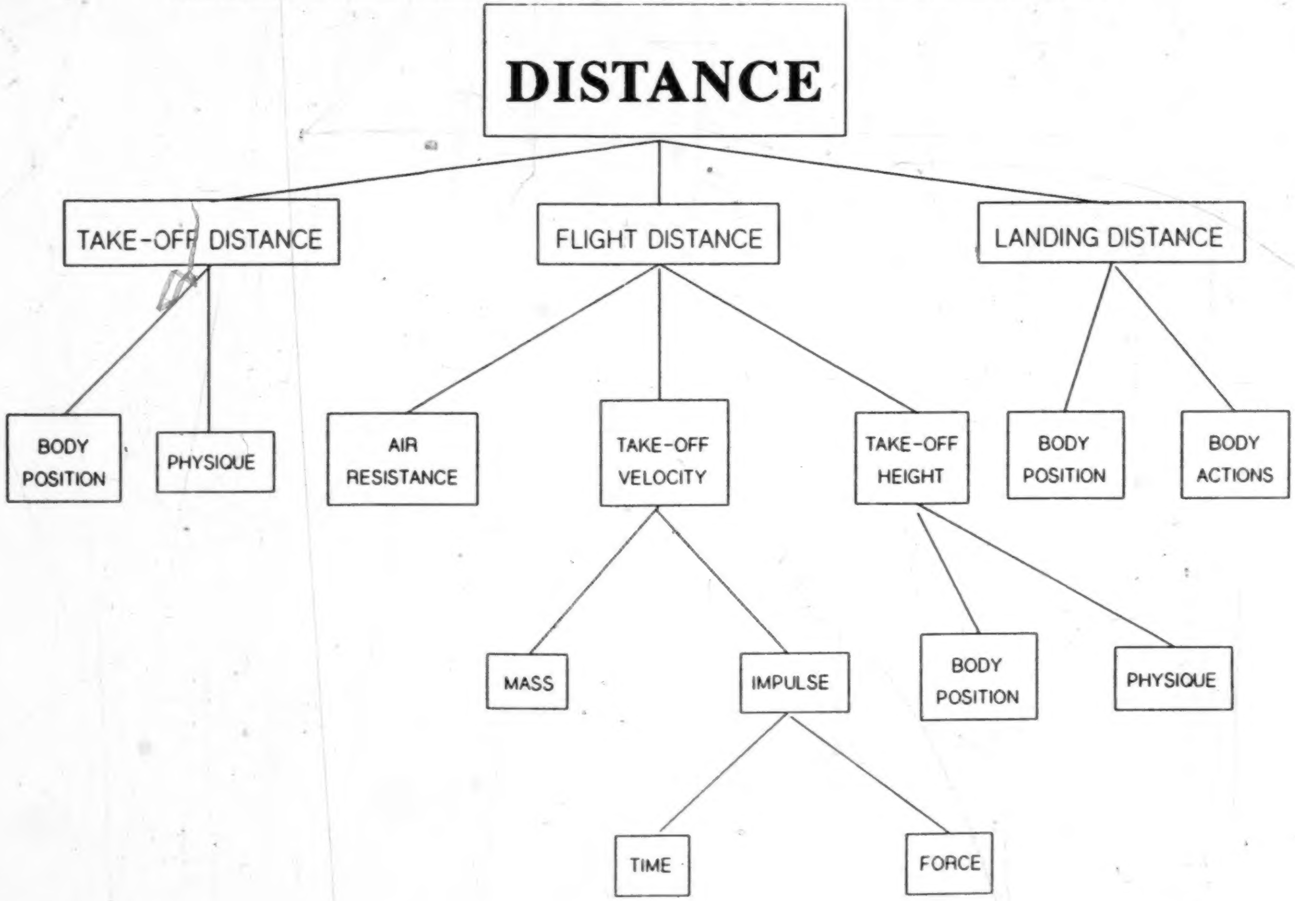
HANDOUT #4.2: A THEORETICAL MODEL FOR THE CARTWHEEL



HANDOUT #4.3: A THEORETICAL MODEL FOR THE OVERARM THROW



HANDOUT #4.4: A THEORETICAL MODEL FOR THE STANDING LONG JUMP



OVERHEAD #5

DEVELOPMENT OF A THEORETICAL MODEL SUMMARY

1. Each of the factors included in the model should be completely determined by those factors that appear immediately below it.
2. Different models can be developed for the same skill.
3. Models should only be developed up to the point that is necessary to determine the critical features.
4. Relationships between the variables at the same levels are not indicated.

CRITICAL FEATURES

- Critical features are components of the movement and the environment that are critical to the outcome of the performance.
- They must be able to be observed and have a reason for being observed.
- Modification of the critical features should affect the outcome of the performance.
- Critical features are inflexible parts of a movement. They can be least modified by individual differences etc... if success is to be achieved.
- A component is critical if its absence or malfunction prevents correct or efficient performance.
- Critical features provide important cues on what to focus on.

MOVEMENT ANALYSIS & CONSIDERATION OF THE DIRECT AND INDIRECT CONSTRAINTS

SESSION #7:
Saturday, November 15, 1986
9:00 - 12:00pm

Session Objectives:

- To complete a number of practice activities on the identification of critical features.
- To discuss and provide examples of possible direct and indirect constraints on the observation process.

Lesson Outline:

1. Recap the steps involved in the conceptual analysis of a skill or movement.
2. Re-emphasize the importance of identifying the critical features for a skill or movement.
3. Discuss the homework assignment on the identification of the critical features for the overarm throw and the long jump.
4. Show the 16mm film on playschool children performing the vertical jump, cartwheel, long jump, and overarm throw. Have the students observe the film to observe the presence or absence of the previously identified critical features.

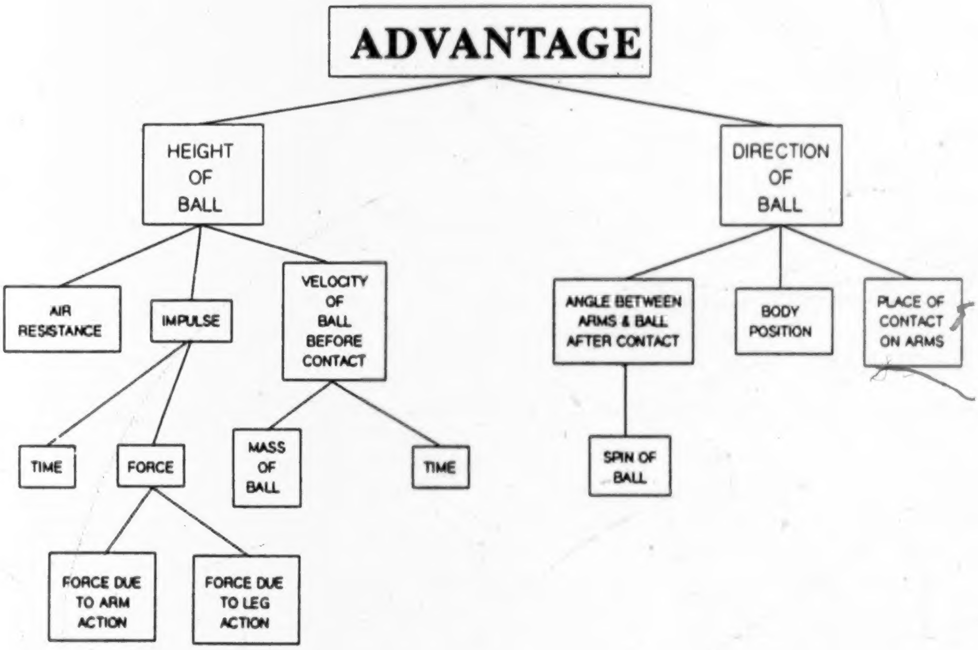
5. Assign Activity #4: CRITICAL FEATURES OF THE FOREARM PASS. Provide the students with a theoretical model for the volleyball forearm pass. Request that one student acts as a demonstrator, while the class, as a group, discusses and identifies the critical features. Allow approximately 30 minutes.
6. Introduce the next stage in the pre-observation phase, the consideration of the direct and indirect constraints on the observation process. Relate the stage to the skill analysis paradigm Handout #1
7. Define and detail the two target goals of this stage, the consideration of the factors which alter the perceptual process, and the consideration of other relevant correlates (see Overhead # 6). Provide personal examples.
8. Stimulate discussion on the stage by asking for examples from the participants teaching and coaching experiences.

Reading:

1. Barrett, K.B., Observation for teaching and Coaching. JOPER, 1979, p. 23-25.
2. Logsdon, B.J, et al, A Focus on the Teaching Process. 1984, p. 269-339 (Chapter 9).

ACTIVITY #4: CRITICAL FEATURES OF THE FOREARM PASS (30 MINUTES)

Using the theoretical model provided for the volleyball forearm pass determine the critical features (One participant should volunteer to be a demonstrator for the volleyball forearm pass).



OVERHEAD #6

FACTORS WHICH AFFECT OUR ABILITY TO PERCEIVE/ATTEND/OBSERVE

The ability to selectively attend to pertinent information is affected by many things. Distractions result in an inability to maintain focus.

External Distractions:

- intensity and size
- contrast
- speed, complexity, repetition
- movement
- teaching area, type & amount of equipment

Internal Distractions:

- motivation
- lack of a visual strategy
- fear, excitement
- observer bias, expectancy

NEED TO RECOGNIZE, ELIMINATE OR MINIMIZE!

OTHER RELEVANT CORRELATES

Physiological: Muscular strength, power, endurance, flexibility, and cardiovascular functioning.

Morphological: Body size, structure, length of limbs...

Event Constraints: may cause the performer to alter their movements from a mechanically ideal to a less then ideal performance. For example: temperature

Aesthetic Considerations: Within a technique, a performer may use individual modifications such as unique timing or movements. These unique and individual adaptations are called STYLE. For example: The run-up pattern for the high jump

PLANNING FOR OBSERVATION

SESSION #8:
Sunday, November 16, 1986
9:00 - 12:00pm

Session Objectives:

- To outline the planning for observation stage of the pre-observation phase.
- To explain the importance of developing an observation plan and recording form.
- To detail the process involved in selecting critical and predictive features, identifying scanning and position strategies, and determining the optimal number of observations.

Lesson Outline:

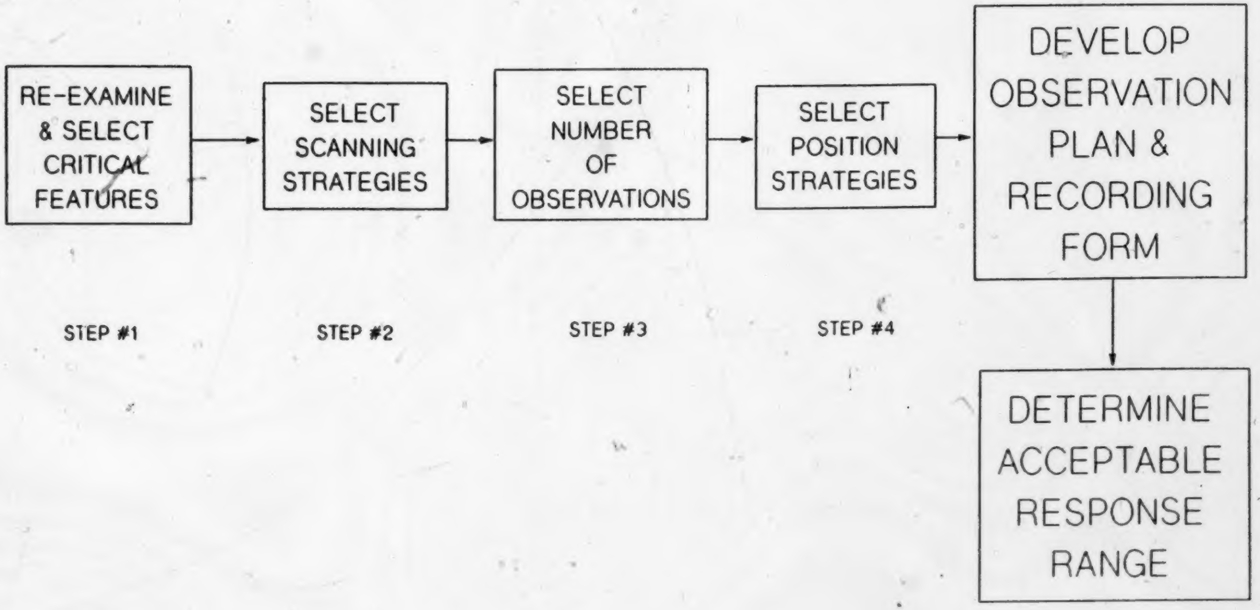
1. Introduce the planning for observation stage(see Overhead #7).
2. Relate the stage back to the skill analysis paradigm (Handout #1) and recap the various components that have been covered up to this point.
3. Provide students with Handout #5 : PLANNING FOR OBSERVATION. Define each of the components of the stage (see Overhead #8).
4. Provide students with an example outline for an observation plan (Handout #6: OBSERVATION PLAN).
5. Define and detail the steps involved in re-examining and selecting the critical features which will be the focus of the observation plan(see Overhead #9).
6. Assign Activity #5: RE-EXAMINE CRITICAL FEATURES. The critical features of the cartwheel are re-examined and selected for a specific observation plan.
7. Define predictive features. Provide examples of possible predictive features for the vertical jump, long jump, and overarm throw.
8. Assign Activity #6: PREDICTIVE FEATURES. Using the critical features selected for the previous activity determine the existence of any predictive features. Discuss each suggestion with the class.
9. Define and detail scanning strategies (see Overhead #9). Provide examples.
10. Assign Activity #7: SCANNING STRATEGIES. Arrange participants into groups of two and three. Assign each group several statements from the activity sheet. Allow each group approximately 15 minutes to discuss their statements and to determine a number of examples which provide a justification for or against the statement. Have each group report to the class and explain their responses.
11. Define and detail the identification of position strategies. Provide students with Handout #7: POSITION GUIDELINES and discuss.
12. Use the filmed performances and videotaped performances of the playschool children to demonstrate the effects of viewing movement from different positions.
13. Assign Activity #8: POSITION STRATEGIES. Arrange participants in groups of two and three. Assign each group one of the four fundamental skills previously discussed. Allow each group approximately 15 minutes to try observing the critical features for their particular skill from a number of different positions. Students record the positions best suited to viewing each of the critical features. These records are used in the development of the observation plan for the group projects next session.
14. Assign Activity #9 : DETERMINATION OF AN ACCEPTABLE RESPONSE RANGE as homework.

HANDOUT #5: PLANNING FOR OBSERVATION

PRE-OBSERVATION

TARGET GOALS

2. PLAN OBSERVATION


RE-EXAMINE & SELECT CRITICAL FEATURES
SELECT SCANNING STRATEGIES
SELECT NUMBER OF OBSERVATIONS
SELECT POSITION STRATEGIES
DEVELOP OBSERVATION PLAN & RECORDING FORM
DETERMINE ACCEPTABLE RESPONSE RANGE
STEP #1
STEP #2
STEP #3
STEP #4

OVERHEAD #8

- Movement observation must be systematic in order for it to be an effective evaluative tool.
- Plan for observation
Observers who try to see everything often end up perceiving nothing (Barrett, 1979)

-An observation plan is designed to relate to a specific task. Each plan is unique.

NEED TO CONSIDER:

1. Task - What is the performance criterion, purpose of the lesson or analysis....?
2. Critical features - What are the critical features which will be the focus of the observation?
3. Predictive features - Are there any features in the movement which may act as critical feature indicators?
4. Scanning strategies - Which scanning strategies will be used to observe the critical features?
5. Number of Observations - How many observations of the skill are necessary?
6. Position - Which positions are best suited to each of the observations?

HANDOUT #6: OBSERVATION PLAN

SKILL ______________ **TASK** (Performance criterion, purpose of lesson...) ______________

SETTING (Direct and Indirect constraints) ______________

OBSERVATION NUMBER	CRITICAL FEATURES	PREDICTIVE FEATURES	SCANNING STRATEGIES	POSITION	ACCEPTABLE RESPONSE RANGE	OBSERVED RESPONSE

OVERHEAD #9

RE-EXAMINE & SELECT CRITICAL FEATURES

Select specific critical features depending on the objectives of the lesson, time, performer's ability ...

1. List all the critical features for the movement or skill.
2. Choose the least redundant set.
3. Select the critical features which will be the focus of the lesson or analysis.
4. Determine the existence of any predictive features.

SCANNING STRATEGIES

WHERE, WHEN, AND HOW LONG TO LOOK FOR?

Need to be able to search systematically for the relevant features. Scanning strategies address the following questions.

1. In which part of the display do the perceptual systems need to be orientated?
2. How to observe the various critical features - focus versus scan?
3. Are there any critical features which need to be observed simultaneously?

ACTIVITY #5: RE-EXAMINE CRITICAL FEATURES
(15 MINUTES)

Listed below are the critical features of the cartwheel that were determined during the movement analysis stage. Re-examine these critical features and select the ones which will be the focus of a specific observation plan.

CARTWHEEL CRITICAL FEATURES

Legs abducted in a split position
Toes pointed
Body line (limbs extended)
Distance the foot is away from the centre of mass
Extension of the ankle
Extension of the knee
Vigourous swing downwards of the arms
Vigourous swing downwards of the trunk
Straight body line
Erect trunk
4 count rythm foot/hand/hand/foot

ACTIVITY #6 : PREDICTIVE FEATURES
(15 MINUTES)

For the critical features which were selected above determine if there are any possible predictive features.

ACTIVITY #7 : SCANNING STRATEGIES
(15 MINUTES)

Discuss the assigned statements (agree, disagree etc... with each of the statements) and determine several examples for each of the statements which serve to exemplify your discussions. Select a spokesperson to report to the class.

1. The point or points on which the observer focuses attention effects what is seen. If an attempt is made to get a general impression of the whole it is unlikely you will get a distinct impression of how any particular part is moving and visa - versa.
2. It is often wise to scan first to get a general picture then focus in on the critical features.
3. Movement observation can be simplified by observing slower moving parts first. It is difficult to see extremities or striking implements that are moving fast. The speed of the movement often increases from the centre of the body out to the extremeties. (Look at the centre of the wheel before observing the rim)
4. Break the skill down into components or phases and just focus on one phase at a time. (If the critical features in each phase are okay sequencing may be the problem)
5. Focus on a given movement or combination of movements long enough to see and describe.
6. Scan for unnecessary movements.
7. Scanning for the range of motion of various body parts may help to assess skills in which the speed or impulse is important.

HANDOUT #7: POSITION

You must be in the right place at the right time! (Barrett, 1979, p. 25)

If the vantage point is not considered other observation techniques may be useless. The optimum position to view from varies from skill to skill, feature to feature. (Brown, 1982)

GUIDE:

1. Move around during the observation session. Different positions provide different information regarding the critical features.
2. In general, the best vantage point is one that is at right angles to the plane of motion.
3. Move far enough away to overcome problems associated with the speed of the performer moving across the observers field.
4. When movement extends over some distance the best vantage point is opposite the midpoint of this distance. The observer must be far enough away to see the entire sequence. When focusing on smaller components of the movement the observer should be quite close to the performer.
5. If orientation is important observe in a setting which has horizontal or vertical reference lines.
6. Position to the outside edge of the teaching area.

ACTIVITY #8 : POSITION
(15 MINUTES)

Observe each of the critical features for your group's assigned skill from a number of different positions. Determine and record the best positions for each of the critical features. Take turns being the performer and the observer.

ACTIVITY #9 : ACCEPTABLE RESPONSE RANGE (HOMEWORK)

DETERMINING AN ACCEPTABLE RESPONSE RANGE

TARGET GOAL: To determine an acceptable response range for the performance of specific critical features based on the information derived from the initial movement analysis and the consideration of the indirect and direct constraints on the observation process.

Construct stick figure drawings depicting an acceptable reponse range for the critical features previously established in the following phases.

1. Cartwheel:
    - Instant of first hand placement
    - Double hand support
2. Long jump:
    - Take-off
    - Landing
3. Overarm throw:
    - Backswing
    - Point of release

DETERMINATION OF AN ACCEPTABLE RESPONSE RANGE AND INTRODUCTION TO THE GROUP PROJECT

SESSION # 9:
Tuesday, November 18, 1986
7:00 - 10:00pm

Session Objectives:

- To outline the importance of determining an acceptable response range.
- To outline the importance of the formation of a mental image.
- To understand the objectives and procedures involved in the completion of the group video project.

Lesson Outline:

1. Go around the class and ask each of the participants for their reactions to the homework assignment. Ask such questions as:
   - Did they find it difficult? Why?
   - How did they go about the homework task?
2. Discuss the objectives of the homework assignment(Activity #9). Detail the process that is involved in determining an acceptable response range. Discuss the benefits of completing this stage of the pre-observation phase. Relate the stage to the skill analysis paradigm (Handout #1).
3. Allow the students to make any modifications to their acceptable response range activities and then collect them.
4. Introduce the group video project (Handout #8: VIDEO PROJECT). Explain the objectives, procedures, and timeline of the project. Explain the presentation requirements and format.
5. Assign the students to the same groups they were in for Activity #8. Assign the remainder of the session to be used to re-examine and select the critical features which will be the focus of the observation plan. The group is responsible for arranging private group meetings prior to the video-taping session.
6. Have class meet back for ten minutes to ask any questions regarding the project.

HANDOUT #8: VIDEO PROJECT

GROUP
SKILL
PERFORMANCE CRITERION
PERFORMER

PURPOSE:
TO DEVELOP AN OBSERVATION PLAN AND RECORDING INSTRUMENT AND TO APPLY THE SELECTED OBSERVATION STRATEGIES TO THE OBSERVATION OF THE ASSIGNED SKILL.

PROCEDURE:

1. Each group member must develop an observation plan for the assigned skill. The plan should include the critical features to be observed in each observation of the skill, the purpose for observing these critical features, selected predictive features, as well as the scanning and position strategies to be used for each observation. You must be able to justify all your choices.
2. Meet with your group and share ideas concerning the plans. Develop one plan and a corresponding recording instrument. Determine an acceptable response range for each of the critical features you have selected to observe.
3. Each group will receive a video system and an assigned work place. Take your equipment and practice applying the observation plan by making a video recording of the performances of your assigned skill. Use the camera controls to simulate the human eye.
4. View each of the recorded trials and complete the developed recording instrument. Prepare a good copy of the plan, recording instrument etc... to be photocopied for each member of the class. Discuss and practice your groups presentation of the project.
5. Class presentations.

PRESENTATIONS:
- Approximately 45 minutes per group.
- Introduce and present the observation plan, recording instrument, and acceptable response range.
- Explain and demonstrate all components of the plan using the prepared video.
- As you present each of the observations state the observed responses.
- All decisions related to the observation plan choices must be justified.

VIDEO-TAPING SESSION

SESSION #10:
Thursday, November 20, 1986
7:00 - 10:00pm

Session Objectives:

- To have a completed and refined observation plan and recording form.
- To complete the video-taping portion of the group project.
- To discuss the preparation and format of the project presentations.

Lesson Outline:

1. Proceed to video-taping venue and pick up equipment. Ensure all groups are familiar with the operation of the equipment.
2. Review each of the developed observation plans to ensure they have been completed adequately.
3. Assign each group a specific area in which to video-tape their skills. Mingle with the groups and be available to troubleshoot.
4. Once the taping is completed have students plan their presentations.

GROUP PRESENTATIONS

SESSION #11:
Saturday, November 22, 1986
9:00 - 12:00PM

Session Objectives:

- To present the group project
- To review and discuss the project presentations made by each of the groups.
- To outline the planning for observation process.
- To understand the adoption of observation strategies required in the observation phase.

Lesson Outline:

1. Allow the groups approximately 45 minutes to practice their presentations and to produce the good copy of their observation plans and recording forms.
2. Make a copy of each of the plans for each of the members of the class.
3. Group presentations. Allow 10 minutes for questions and discussion.
4. Provide an overview of the presentations highlighting the positive aspects of each of the observation plans and recording forms.
5. Recap the planning for observation process. Ask each of the participants to comment on the process of the video project.
6. Relate the tasks involved in the video-project to the observation phase of the skill analysis paradigm (Handout #1).

DIAGNOSIS AND REMEDIATION

SESSION #12:
Sunday, November 23, 1986
9:00 - 12:00pm

Session Objectives:

- To consider Hoffman's Hypothetico-Deductive model for problem solving.
- To apply Hoffman's model as a basis for determining the nature and extent of a discrepancy between the observed and the desired response.
- To determine the errors in a performance.
- To discriminate between the primary and secondary errors.

Lesson Outline:

1. Recap the progression through the skill analysis paradigm to date.
2. Introduce and discuss Hoffman's Hypothetico-Deductive model for problem solving (see Overhead #10).
3. Provide students with Handout #9: DIAGNOSTIC PROBLEM SOLVING. Apply the approach to the filmed performances of the four demonstration skills.
4. Define and detail the steps involved in determining the primary errors in a performance (HANDOUT #10: DIAGNOSIS). Provide examples using the filmed performances of the four demonstration skills.
5. Assign Activity #10: DIAGNOSIS & REMEDIATION ACTIVITY. Have students return to their video project groups to complete the activity. Allow each group approximately 25 minutes to discuss and record their responses. A spokesperson from each group reports their results to the class using the video-taped performances to exemplify their findings.
6. Provide an overview of the final phases of the skill analysis process. Highlight the importance of discriminating between the primary and secondary errors.

Readings:

1. Hoffman, S.J., Clinical Diagnosis as a Pedagogical Skill. In Thomas J. Templin & J. Olsen (Ed's) Big Ten Body of Knowledge Symposium Series, Ilanois: Human Kinetic Publishers, 1982.

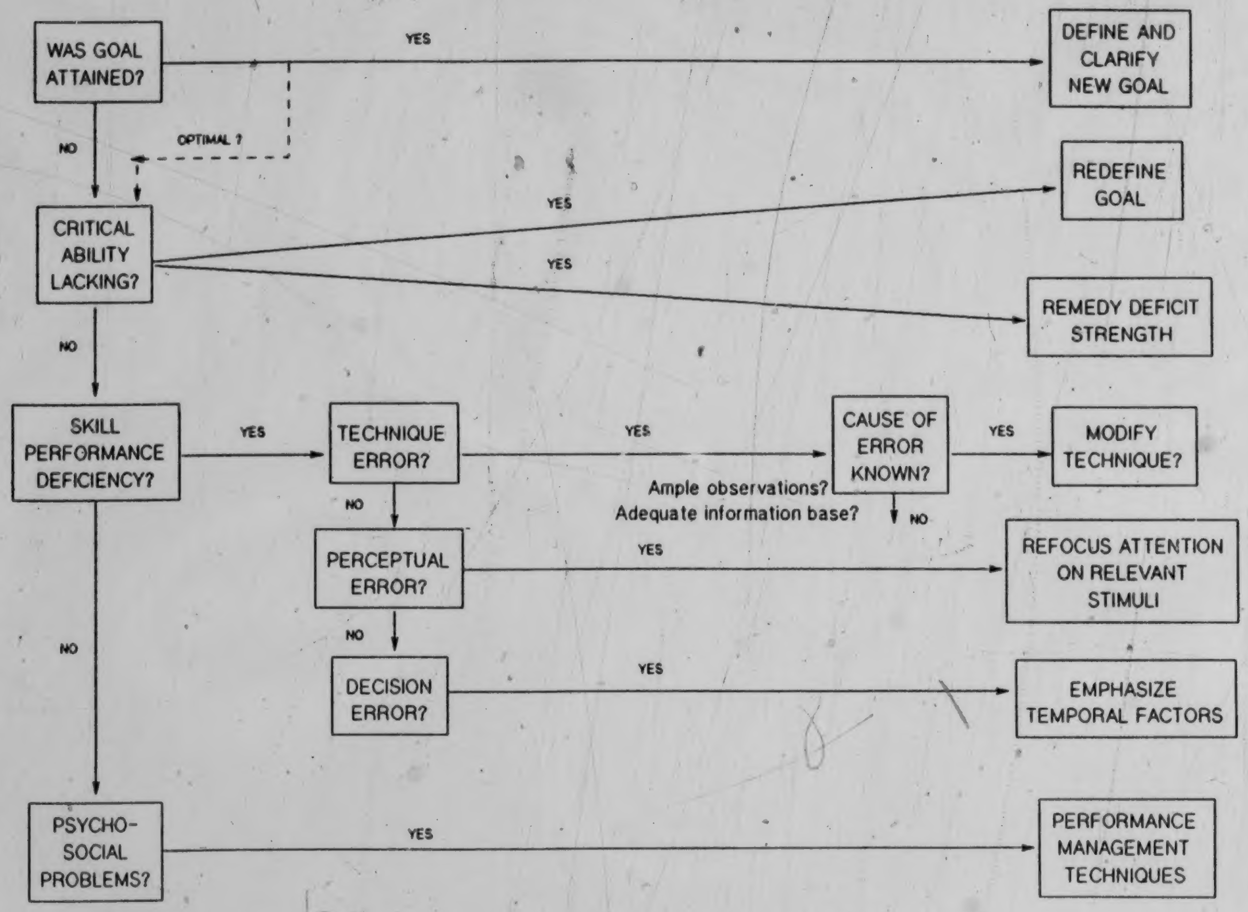
OVERHEAD #10
DIAGNOSIS & REMEDIATION

Hoffman (1982) posed a Hypothetico-Deductive model as a diagnostic problem solving tool.

- The model is based on the assumption that discrepancies between the observed and desired response require specific prescriptions.

Three major decisions:

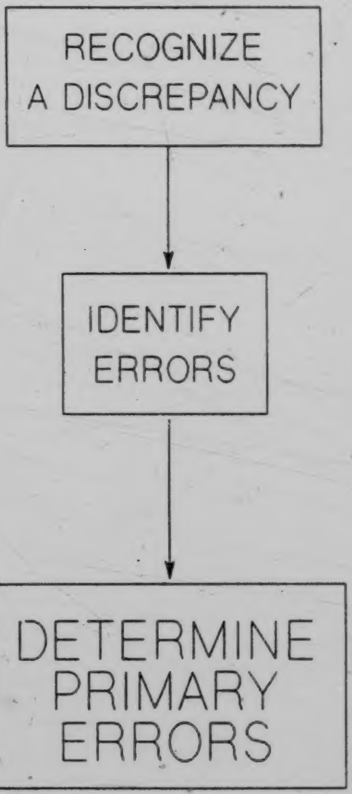
1. Has the learner performed the skill correctly?
2. If not - What features of the performance are errors? Primary versus secondary errors?
3. What prescription will remediate the errors?



HANDOUT #9: DIAGNOSTIC PROBLEM SOLVING (Adapted from Hoffman, 1982)

HANDOUT #10: DIAGNOSIS

DIAGNOSIS



STEP #1 — RECOGNIZE A DISCREPANCY

STEP #2 — IDENTIFY ERRORS

TARGET GOAL — DETERMINE PRIMARY ERRORS

ACTIVITY #10: DIAGNOSIS & REMEDIATION
(25 MINUTES)

Discuss the observations which you recorded during the preparation of your video presentations. Determine if there were any discrepancies between the observed and desired responses. Apply Hoffman's model for problem solving to determine the nature of the discrepancy. If an error in technique is deemed to be the problem, determine if it is a primary or secondary error. Form a remedy for each of the technique errors.

SUMMARY OF THE SKILL ANALYSIS PARADIGM

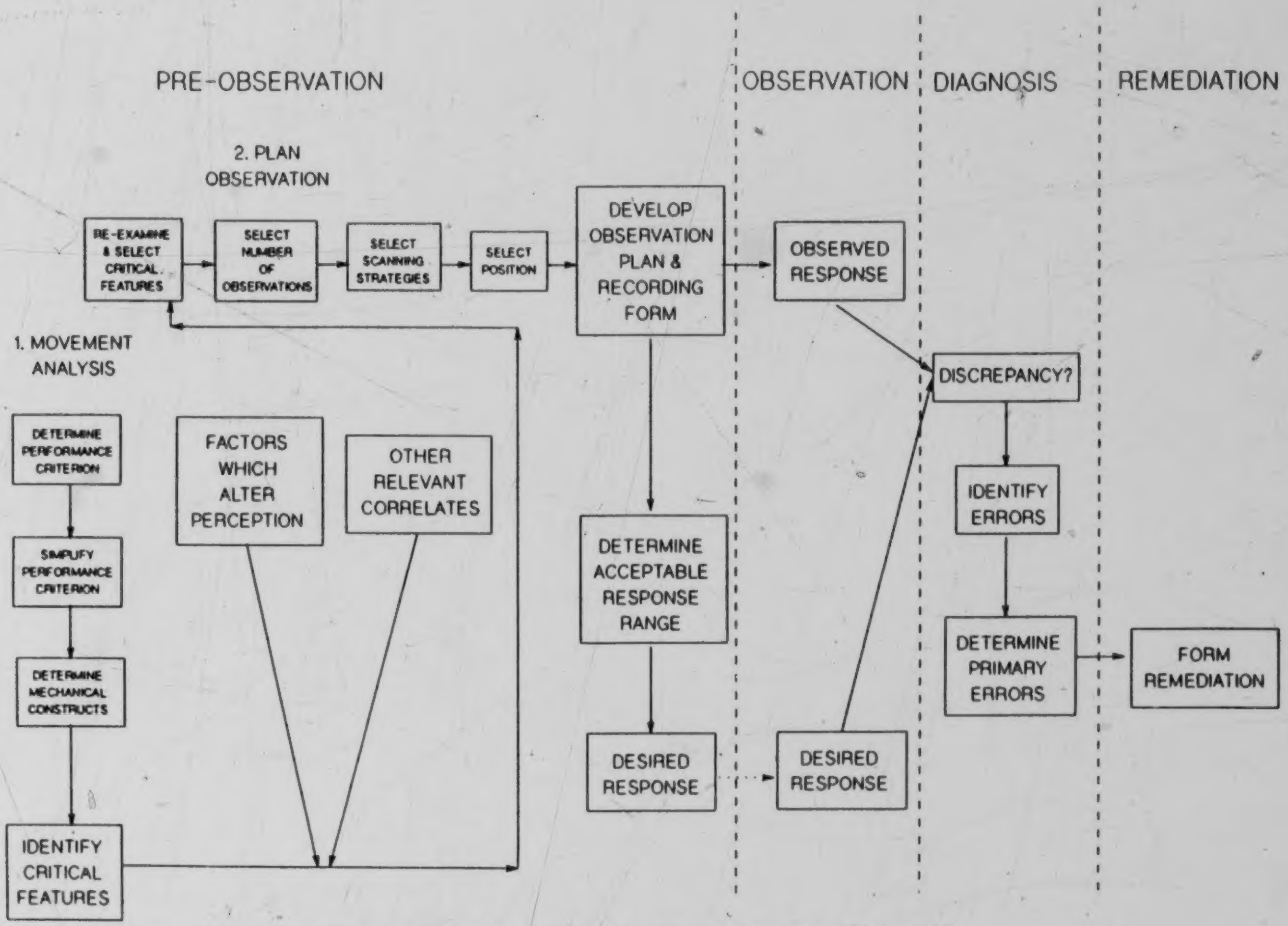
SESSION #13:
Tuesday, November 25, 1986
8:15 - 10:00pm

Session Objectives:

- To consider the skill analysis paradigm in its entirety.
- To understand the nature and extent of the skill analysis process.
- To complete the first step in the final practical assignment.

Lesson Outline:

1. Provide students with the detailed version of the complete skill analysis paradigm (Handout #11: SKILL ANALYSIS PARADIGM). Outline and redefine each of the phases of the skill analysis process. Provide a brief overview of the methods which were used to present each of the phases.
2. Provide students with a list of summary quotes (Handout #12: QUOTES). Discuss each of the quotes and how it relates to the development and implementation of a program designed to promote skill analysis competency.
3. Provide a brief discussion on other applications of the skill analysis paradigm (ie. forms of skill analysis in which the focus of the analysis is not technique).
4. Introduce the objectives and procedures of the final practical assignment. Outline the timeline for the assignement.
5. Implement the final practical assignment test session #1.


PRE-OBSERVATION
OBSERVATION
DIAGNOSIS
REMEDIATION
2. PLAN OBSERVATION
RE-EXAMINE & SELECT CRITICAL FEATURES
SELECT NUMBER OF OBSERVATIONS
SELECT SCANNING STRATEGIES
SELECT POSITION
DEVELOP OBSERVATION PLAN & RECORDING FORM
OBSERVED RESPONSE
1. MOVEMENT ANALYSIS
DETERMINE PERFORMANCE CRITERION
SIMPLIFY PERFORMANCE CRITERION
DETERMINE MECHANICAL CONSTRUCTS
IDENTIFY CRITICAL FEATURES
FACTORS WHICH ALTER PERCEPTION
OTHER RELEVANT CORRELATES
DETERMINE ACCEPTABLE RESPONSE RANGE
DESIRED RESPONSE
DESIRED RESPONSE
DISCREPANCY?
IDENTIFY ERRORS
DETERMINE PRIMARY ERRORS
FORM REMEDIATION

HANDOUT #11: A PARADIGM FOR SKILL ANALYSIS

SUMMARY QUOTES

Experienced clinicians teaching skills with which they are familiar resort to trouble shooting. Through repeated analysis of the skill, they have learned to focus directly on the source of difficulty. Some may not even appreciate or understand the mechanical laws that govern the relationships between primary and secondary errors. Granted this does not mean that a knowledge of mechanics would not improve their diagnostic abilities but that remains a question to be examined.
(Hoffman, 1982, p. 4)

The more you can draw on your knowledge base, the more faith you can have in your interpretation and the more choices you have. (Logsdon, 1984, p. 305)

The expert is able to monitor certain movement patterns at a level that does not have to be under conscious control. Once something is learnt and automated it is removed to a lower level and does not have to be consciously monitored all the time. (Lewis, 1980, p. 41)

In the absence of preserved graphic records of the movement, the teacher conducts ex-post facto analyses of rapidly decaying precepts etched not on film but on the illusive territory of the minds eye. (Hoffman, 1974, p. 74)

Since each of the skills is made up of various movements, it seems to me that teacher preparation programs could use time more wisely if they were to teach observation of movement as a totality. If prospective Physical Educators are taught to observe movement, they could learn to apply their observation abilities to any movement within any skill. (Craft, 1977, p. 51)

Skill teachers can no more spontaneously evolve effective diagnostic strategies for gymnastic or volleyball instruction out of a melange of theoretical coursework offered up by the academics, (most of who are neither interested nor knowledgable in the kind of clinical decision-making required in pedagogy) than medical students can spontaneously evolve an effective method of diagnosing encephalitis from a basic course in anatomy and physiology. (Hoffman, 1982, p. 41)

Contrary to longstanding belief, biomechanists do not have the monopoly on the knowledge required for a clinical analysis of a motor performance, teachers and coaches, like medical clinicians, must draw from what academics have treated as disparate bodies of knowledge. They don't evaluate a motor performance from the perspective of an exercise physiologist, a motor behaviorist, a sport psychologist, or a biomechanist but as a clinician whose questions usually cut across the boundries of all the subdisciplines. (Hoffman, 1984, p. 70)

FINAL PRACTICAL SESSION #1

SESSION #14:
Thursday, November 27, 1986
7:00 - 10:00pm

Session Objectives:
- To complete a conceptual analysis of the gymnastics squat vault.
- To consider the direct and indirect constraints on high school students' performances of the vault.

Lesson Outline:
1. Re-cap the objectives and the procedures involved in the final practical assignment.
2. Provide the students with a resource package on the squat vault.
3. Have students work in groups to identify the critical features for the vault. Have the expert in the group act as a resource person.
4. Go to the gymnasium to view performances of the squat vault performed by a skilled gymnast.
5. As a class discuss the possible direct and indirect constraints on the observation.
6. Assign as homework the development of an observation plan and recording form for the squat vault.

FINAL PRACTICAL ASSIGNMENT SESSION #2

SESSION #15:
Sunday, November 30, 1986
9:00 - 12:00pm

Session Objectives:

- To refine the developed observation plans and recording forms for the squat vault.
- To consider the development of an acceptable response range.
- To complete the second testing session.
- To describe the actions involved in the power skating skill, one-foot edging.

Lesson Outline:

1. Have students work in groups of two and three to discuss and refine their developed observation and recording forms.
2. Have students discuss and determine an acceptable response range for the vault.
3. Implement the final practical test session #2.
4. Introduce and describe the power skating skill. Provide an off-ice demonstration of the skill.
5. Present a discussion on the movement principles that affect the performance of the skill.
6. Assign as homework the consideration of the movement analysis stage for the skating skill.

FINAL PRACTICAL ASSIGNMENT SESSION #3

SESSION #16:
Wednesday, December 3, 1986
8:00 - 11:00pm

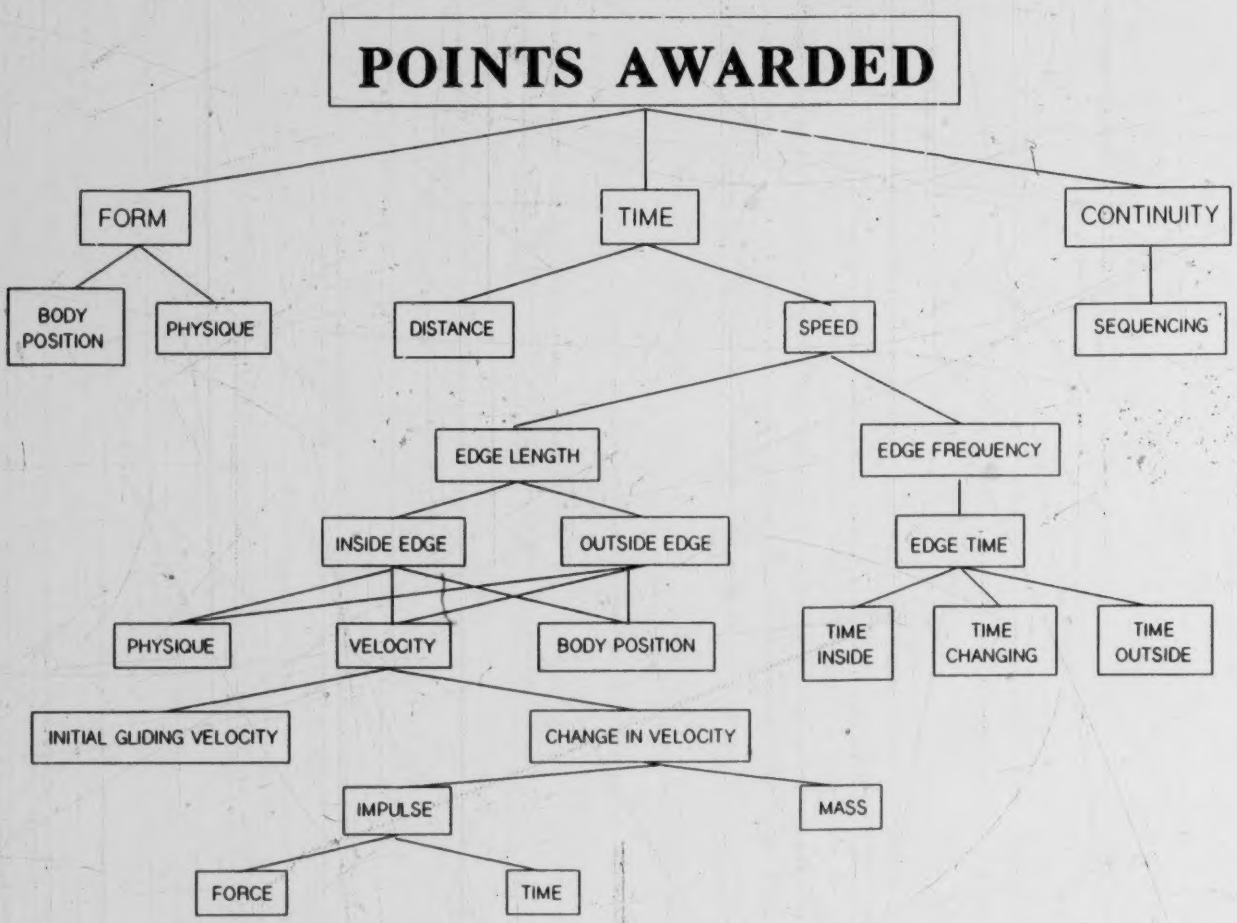
Session Objectives:

- To follow the conceptual analysis of one-foot edging
- To consider the direct and indirect constraints on the observation of the skating skill performed by a group of university students.
- To develop an observation plan and recording form for the skating skill.
- To consider the development of an acceptable response range.
- To complete the third testing session.

Lesson Outline:

1. Go through the conceptual analysis of the skating skill (Handout #13: SKATING SKILL). Discuss and determine the critical features as a class.
2. As a class discuss the possible direct and indirect constraints on the observation of the skill.
3. Have students work in groups to develop an observation plan, recording form, and an acceptable response range.
4. Implement the final practical testing session #3.

HANDOUT #13: A THEORETICAL MODEL FOR ONE-FOOT EDGING



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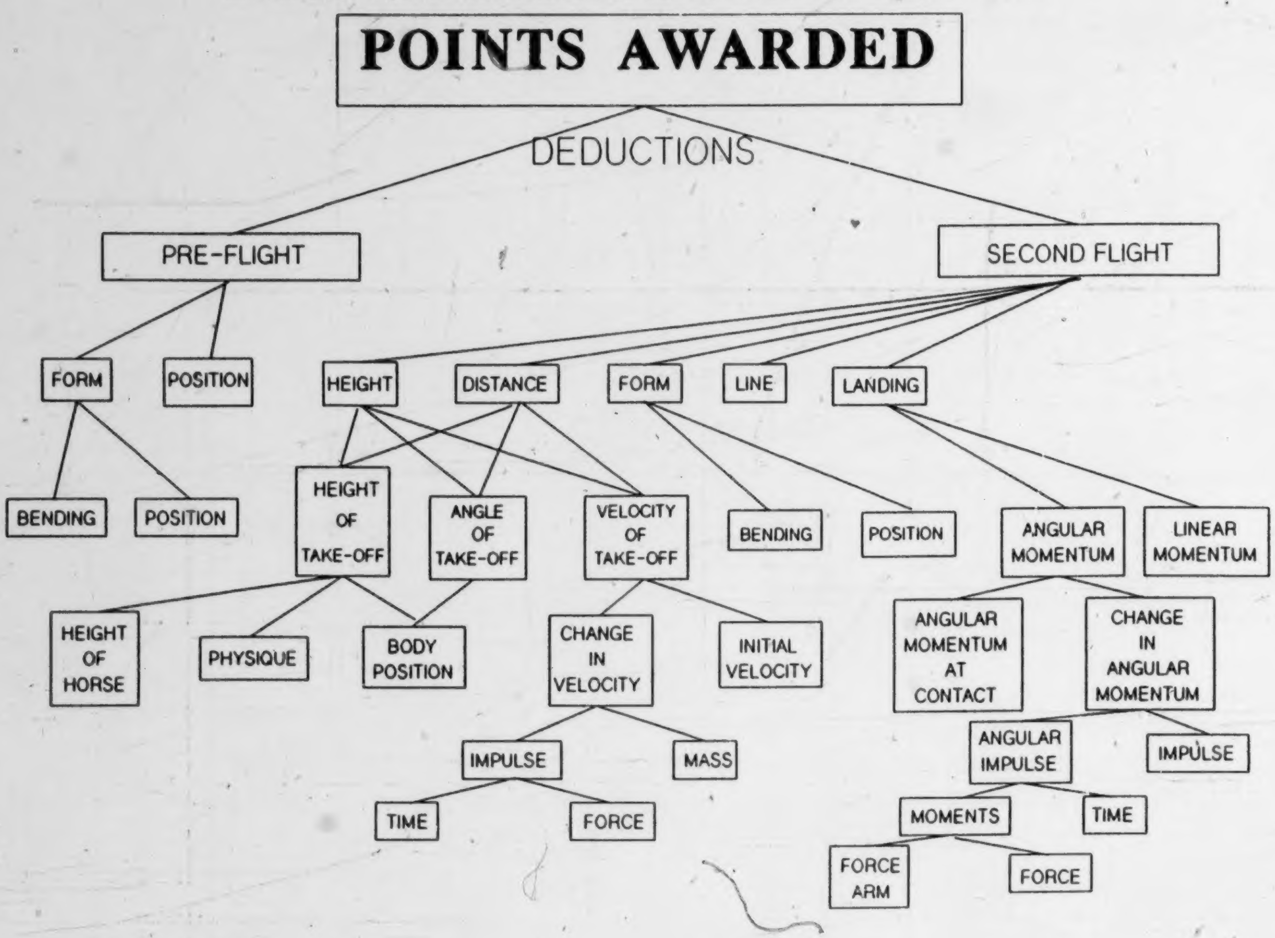
APPENDIX 9: FINAL FIELD TEST COURSE SCHEDULE

DATE	TIME	TOPIC
04/11/86	8:15-9:30pm	Course Introduction
06/11/86	7:00-10:00pm	Introduction to Training Program
08/11/86	9:00-12:00pm	Biomechanics Review
09/11/86	9:00-12:00pm	Biomechanics Review
11/11/86	2:00-5:00pm	Biomechanics Review, Movement Analysis
13/11/86	7:00-10:00pm	Movement Analysis
15/11/86	9:00-12:00pm	Indirect & Direct Constraints, Planning Observation
16/11/86	9:00-12:00pm	Planning Observation
18/11/86	8:15-9:30pm	Determine Acceptable Response Range, Video Project
20/11/86	7:00-10:00pm	Video Project
22/11/86	9:00-12:00pm	Video Project, Diagnosis & Remediation
23/11/86	9:00-12:00pm	Diagnosis & Remediation
25/11/86	8:15-9:30pm	Skill Analysis Paradigm Summary
27/11/86	7:00-10:00pm	Final Assignment
30/11/86	9:00-12:00pm	Final Assignment
03/12/86	8:00-11:00pm	Final Assignment

SQUAT VAULT CRITICAL FEATURES

FACTOR/PHASE	CRITICAL FEATURES
PRE-FLIGHT	Plantar flexion
	Complete knee extension
	Body lean (C/M ahead of trunk)
	Hollow extended body
	Body raises up close to horizontal position just prior to hand/horse contact
SECOND FLIGHT	Shoulder retraction/protraction
	Extension of elbows
	Push-off completed before shoulders cross vertical
	Hips shoot through
	Explosive extension of wrist and shoulders
	Extension through a large range of motion
	Shoulder flexion
	Flight occurs in sagittal plane
LANDING	Full body extension
	Vertically extended body over base of support
	Flexion of hips, knees, ankles, thigh
	Optimal range of motion

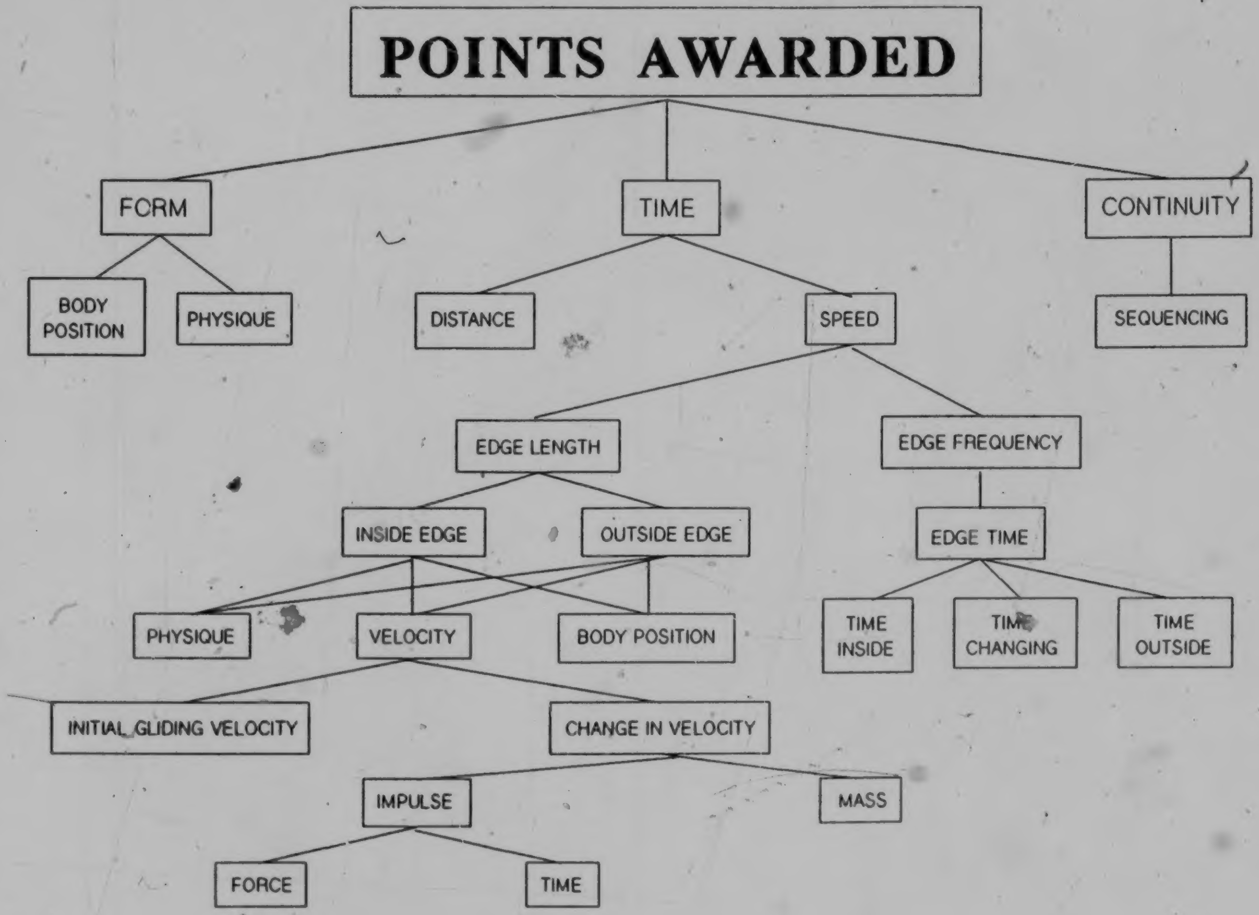
APPENDIX #10: A THEORETICAL MODEL FOR THE SQUAT VAULT



ONE-FOOT EDGING CRITICAL FEATURES

FACTOR/PHASE	CRITICAL FEATURES
FORM	Erect trunk
	Head up
	Free leg extended over skate
	Arms abducted and controlled
	Arms rotate in transverse plane
TIME	Plantar/dorsi flexion
	Knee flexion/extension
	Hip flexion/extension
	Trunk rotation in transverse plane
	Arms, shoulder rotation
	Large range of motion
	Slight unweighting of skating foot
	Body leans over to inside of new circle radius
	Simultaneous rotations of upper body
	Transfer ends in flexion over new edge
	Free leg draws over new edge
RHYTHM	Edge #1 - flexion of hip, knee, ankle
	Edge #2 - extension of hip, knee, ankle during the weight transfer
	Flexion and extension act continuously
	Thigh, ankle, hip rotate simultaneously during the unweighting in weight transfer
	Rhythm between lower and upper body rotations

A THEORETICAL MODEL FOR ONE-FOOT EDGING



LACROSSE CRITICAL FEATURES

FACTOR/PHASE	CRITICAL FEATURES
ACCURACY	Lower arm and shoulder raise end of crosse up and forward in direction of pass
	Body movements during swing occur in flight path
	Crosse should be perpendicular to flight path
	Angle of crosse at release
	Top hand near top of stick
	Palm of top hand behind crosse
	Bottom hand grips butt
DISTANCE	Leg opposite the throwing hand is forward
	Crosse is brought beside body with right shoulder pulling back
	Gripping palm hand moves back
	Both hands work together
	Bottom hand lifts end of crosse forward and up pointing in direction of pass then pulls down
	While upper hand reaches up and over and follow through in same direction
	Simultaneously with above weight transfer rear to front
	No pause through movement
FORCE	Partial extension of back knee during release phase
	Plantar flexion
	Extension and rotation of trunk
	Pull with bottom shoulder and arm
	Extension of top shoulder and arm
	Extension of wrist
TIME	Large range of motion

A THEORETICAL MODEL FOR THE LACROSSE PASS